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JULY 6, 1961

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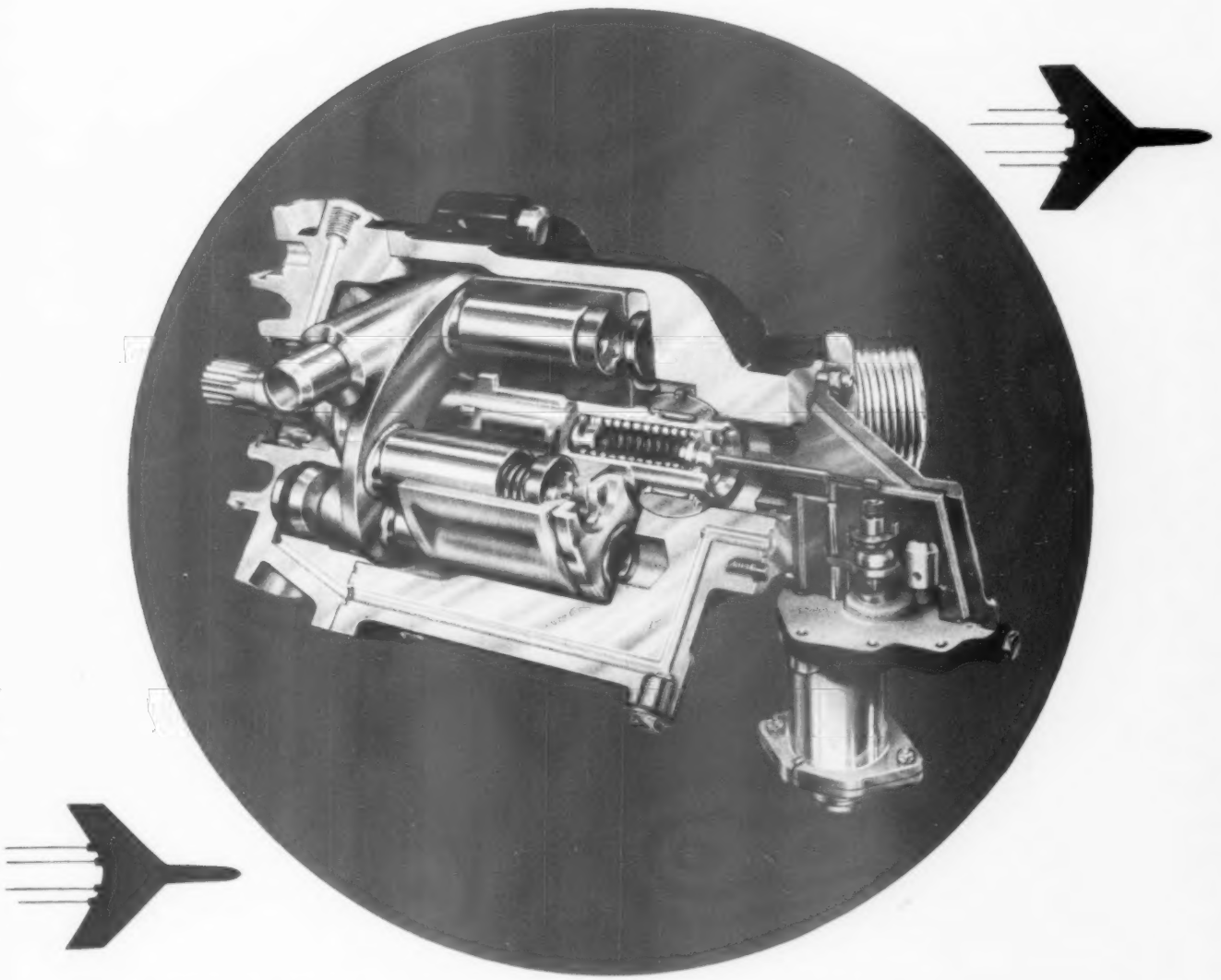

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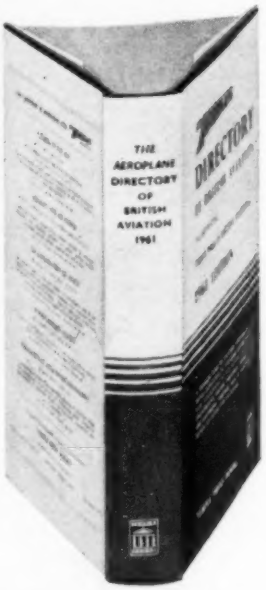

Principal Contents

R.A.F. & Commonwealth Air Force Appointments
Service Air Stations
Foreign Air Attaches
Aviation Ministries and Authorities
The British & Commonwealth Aircraft Industries
Air Transport Operators
Airline Transport Pilots Licence Holders
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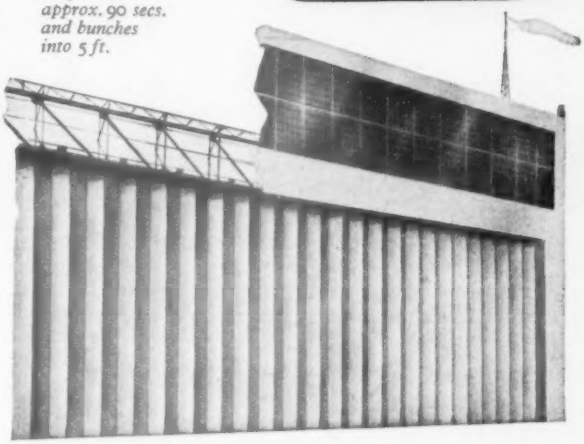

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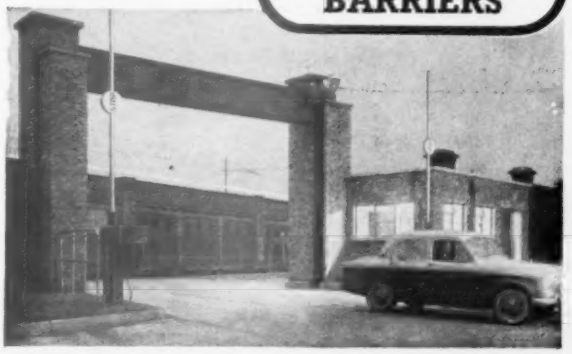

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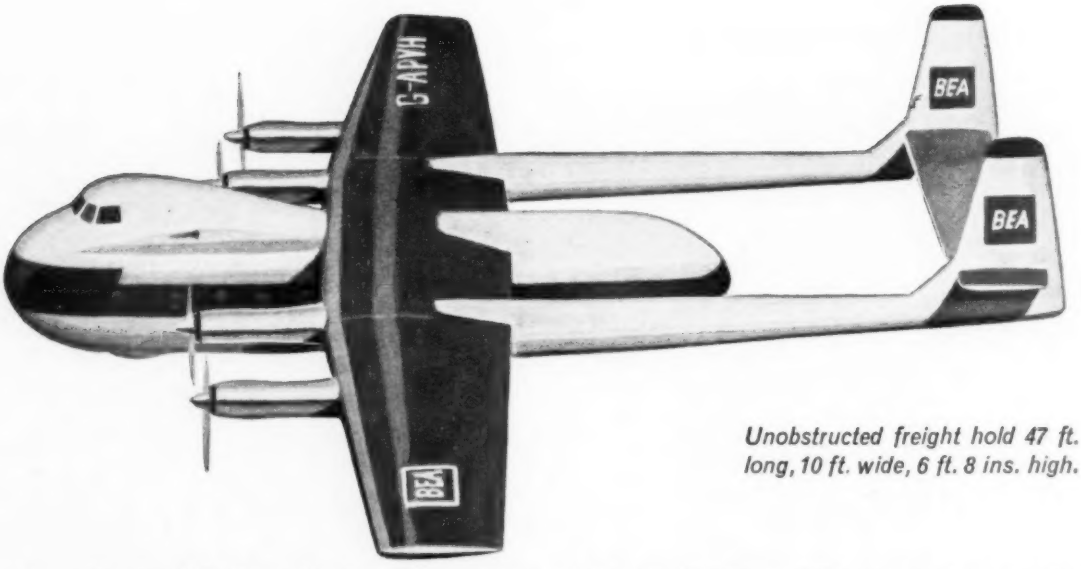

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The Armstrong Whitworth Argosy, powered by Rolls-Royce Dart engines, will be delivered to British European Airways this autumn.
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THE AEROPLANE and ASTRONAUTICS

VOLUME 101 NUMBER 2594 JULY 6, 1961

Quietude—the Urgent Need

Noise is not only a burden on the community at large but it is imposing economic sanctions on commercial aircraft operations. One speaker at the recent conference on the subject at the National Physical Laboratory estimated that for the 200 or so heavy jet transports now in service, costs of nearly £1,000,000 a year were involved in keeping down the emission of noise. And with things as they are we should guess that such burdens seem likely to be enhanced rather than lightened.

It is not long (Jne. 21) since a deputation from certain local authorities within a 10-mile radius of London (Heathrow) Airport was received by Mr. Peter Thorneycroft and members of the Ministry of Aviation. The deputation was concerned about the noise of aircraft and the Minister was concerned to demonstrate that his Ministry was treating the problem seriously.

We doubt, however, whether at this stage it is possible to look forward to the introduction of quieter aircraft. The Ministry, for instance, was specific in a statement that the noisier freight aircraft would be progressively superseded by quieter types. Noise is a matter of energy. And as more and more power is made available for the propulsion of aircraft, more and more energy tends to be released in the form of noise. It is true that the coming into service of powerplants with high by-pass ratios will help. But there can be no doubt that the welfare of the steadily increasing population of these islands and, in particular, the increasing density of population round urban areas, will demand more and more attention to the means of reducing noise.

* * *

Those who have to work out schemes for insulating buildings against noise seem pessimistic if one is to judge from "Building Research, 1960," a report signed by Mr. F. M. Lea, director of the Building Research Station, Garston, and published by the Stationery Office. Incidentally, the report discloses that from inspections so far made, it would appear that an aircraft flying supersonically above 30,000 ft. will perhaps cause only one case of very minor damage. At 20,000 ft. it may produce a number of cases of minor damage. At very low altitudes of the order of 1,000 ft., however, supersonic flight may cause extensive damage, particularly to windows, as was experienced when an aircraft flew at this altitude supersonically over buildings on the Ottawa airfield.

The coming of the turbine has revolutionized the comfort of travel for the air passenger, but it has resulted in such an imposition of noise on those left behind on the ground that the operators, as we have said earlier, have had costly sanctions imposed. With the marginal economics of airline operation there is thus every commercial inducement to discover and introduce means of noise suppression which shall not increase operating costs.

In the past spectacular prizes and competitions have been organized for aeroplanes that flew fastest, highest and farthest. Has the time not come for some benefactor of the human race to give a prize for the aeroplane that shall fly fast, high and far but do it quietest?

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Matters of Moment

The S.B.A.C.'s Next President

FROM the Council of the Society of British Aircraft Constructors has come an announcement that the Hon. H. G. Nelson, M.A., M.I.C.E., M.I.Mech.E., M.I.E.E. has been elected president of the Society for 1961-62, to succeed Sir George Dowty who becomes deputy president. Sir Roy Dobson, C.B.E., Hon.F.R.Ae.S., the announcement discloses, has been elected vice-president and so, by custom, becomes president-elect for next year.

Born in 1917, Mr. Nelson was educated at Oundle and King's College, Cambridge, whence he graduated in 1937. Two years later, after spending some time in France and Switzerland, he went to work in the English Electric factory at Preston. He has, in fact, spent his whole working life associated in one way or another with that company and in the post-war years has had much to do with its development into a leading manufacturer of military aircraft and equipment.

He first joined the English Electric Preston team, as works superintendent. The following year he became assistant works manager and in 1941, deputy works manager. When English Electric took over the Napier company in 1942, Mr. Nelson became its managing director—a post he held until 1949 when he was appointed deputy managing director of the parent English Electric company. More recently he became its managing director and chairman of English Electric Aviation. And, following the various rearrangements concerned with the absorption of English Electric Aviation into the British Aircraft Corporation, he has also been appointed deputy chairman of the Corporation.

In addition to his active concern with English Electric and B.A.C. affairs, Mr. Nelson has been industrial leader and vice-chairman of the Government's Advisory Council on Middle East Trade since 1959. Between 1955 and 1958 he was a member of the Lord President's Advisory Council on Scientific Policy. He was recently appointed a Director of the Bank of England; and has been a member of the S.B.A.C. Council since 1943. He has been vice-president of the Society for the past 12 months.

The Hon. H. G. Nelson, deputy chairman of the British Aircraft Corporation and chairman of English Electric Aviation, who has been appointed president of the S.B.A.C. for 1961-62.

First Lightplane at L.A.P.

ALTHOUGH final procedures have yet to be announced by M.o.A. for single-engine lightplanes to operate into London Airport (THE AEROPLANE AND ASTRONAUTICS, Jne. 29), the first such arrival was made last Saturday, Jly. 1, by a Mooney Mk. 21 four-seat tourer. The Mooney, which is an all-metal version of the wooden-winged Mk. 20A, was also the first of its kind to reach Europe, after a non-stop ferry flight from Boston to London.

Flown by Walter Moody of the Max Conrad organization, the 180-b.h.p. Mk. 21 covered the 3,300 st. miles in a flight time of about 20 hr. 33 min., giving an overall ground speed of more than 160 m.p.h. It carried a 140-U.S.-gal. fuselage ferry tank in addition to its normal wing tankage of 48 U.S. gal. It arrived three minutes after its E.T.A., which had been established a week previously, following slightly circuitous routing by London radar to fit it into the pattern.

The Mk. 21 was delivered to R. K. Dundas, Ltd., U.K. agents for Mooney, for use as a demonstrator. Its delivered and duty paid price of about £7,350 is remarkably low for an aircraft of its category.

Powerplant Export Order

IT is good to learn from Napier Aero Engines, Ltd., the new company formed last month by Rolls-Royce, Ltd., and D. Napier and Son, Ltd., that it has received a £1.2 million Australian contract for Gazelle free-turbine engines. These are to power the 27 Westland Wessex Mk.31 helicopters on order for the Royal Australian Navy. The total value of the Wessex order, including the setting up of maintenance and overhaul facilities in Australia, is reported to be of the order of £6 million.

This is the new engine company's first export order. It follows closely the recently announced requirement for an uprated Gazelle for the Royal Navy.

These Wessex helicopters for the Royal Australian Navy are to be used for anti-submarine duties. According to reports the order is expected to be completed by the summer of 1963.

The Gazelle has been designed specifically as a helicopter powerplant and can be mounted in any attitude between the vertical and the horizontal to suit the application concerned. In the Wessex, the engine is in the nose and inclined at about 35°.

Beagle Finance Facilities

THE Beagle group has created an innovation in aviation commercial practice by creating a financial subsidiary within its organization. The new company, Beagle Aviation Finance, Ltd., offers facilities for both the leasing and hiring of Beagle aircraft, with a consequent streamlining of financing arrangements.

Two basic schemes are available. The aircraft can be leased over a five-year period at an annual rental of one quarter of the cash price, after which the lease is renewable annually at a rental of one-sixteenth of that price. During the period of the lease, all the costs of the aircraft are chargeable to the lessee's revenue account.

Alternatively, purchasing an aircraft out of income can be arranged over a period of three years following an initial down payment of not less than one fifth of the cash price. As with leasing arrangements, the finance charge and running costs are chargeable to the purchaser's revenue account, but the instalments are, of course, chargeable to capital account.

Transit, Injun and Greb

AN otherwise successful attempt to launch three satellites from one rocket—a two-stage Thor-Able Star—was slightly marred on Jne. 29 by the refusal of two of the payloads to separate after arriving in orbit. The trio comprised a 175-lb. Transit IV-A navigational satellite of new "pillbox" configuration and two radiation-measuring satellites, Injun and Greb III. Originally attached to each other by spring mechanisms, these last two appear to have remained locked together.

Last week-end, the two satellite components, together with the final stage of the carrier rocket, were said to be moving close together in near-circular orbits with apogees of about 575 miles. The orbital paths extend some 67 degrees north and south of the equator.

The fact that Transit separated from the other two is significant for it contains a small "atomic battery" which otherwise, might have seriously interfered with measurements obtained by Greb and Injun. This represents the first use of nuclear energy in a space-vehicle. The SNAP (System for Nuclear Auxiliary Power) generator derives its energy from heat produced by the radioactive decay of a small cylindrical pellet of plutonium-238. Weighing only 4½ lb., the generator supplies two of Transit's four radio transmitters with 2·5W. and "will operate for decades"; at least 3½ tons of conventional batteries would be required to duplicate its work.

Operational models of Transit navigational satellites, expected next year, will use similar SNAP generators.

Contamination risks arising from a possible launching failure from Cape Canaveral were considered to be slight in view of the small amount of radioactive material involved. Nevertheless, the plutonium aboard Transit IV-A was encased in a "heavy metal shell" and the U.S. Defense Department is reported to have informed all countries along the take-off route —except Cuba!—of the nature of the experiment.

Of the other two satellites, Greb III, weighing 55 lb., is instrumented to measure X-ray emanations from the Sun, while the 45 lb. Injun is equipped to measure the intensity of radiation in the inner Van Allen belt. Solar batteries energize the transmitters of the scientific payloads and the two remaining transmitters of Transit IV-A.

Going to Glasgow

DR. T. R. F. NONWEILER, of Queen's University, Belfast, has been appointed to the Mechan Chair of Aeronautics and Fluid Mechanics at Glasgow University to succeed the late Prof. W. J. Duncan. Dr. Nonweiler was at the College of Aeronautics before he went to Belfast to become senior lecturer in aeronautical engineering.

He has done a considerable amount of research into the problems of man-powered flight and designed an aircraft of that type which was to have been built at Belfast; this promising project has not come to fruition, however, because of lack of funds. More recently, Dr. Nonweiler has been concerned with space problems—especially that of re-entry of a space vehicle.

Soviet Models on View

FOLLOWING our preliminary note, last week, of things to see at the Soviet Trade and Industry Exhibition, which opens tomorrow, some more information has become available concerning the aeronautical exhibits. Besides the replicas of Sputniks and other "space" items, in the Transport section there will be scale-models of such aircraft as the Tu-104, Tu-114, Tu-124, Il-18, An-10 and An-24 transports; and the Mi-1, Mi-4, Mi-6, Yak-24 and K-18 helicopters. Films will also be shown depicting the rôle of Soviet aviation in agriculture, sport, medicine, freighting and building.

Major Gagarin's Vostok spacecraft will not, after all, be displayed. According to a Soviet official, it was "too big to accommodate in the exhibition and there was no time to construct a scale model."

Air Matters in Parliament

Deterrent Policy

IN the House of Commons on Jne. 14, NATO policy and Britain's rôle in its implementation were again discussed when MR. E. J. ST. L. STRACHEY (Lab., Dundee, W.) put to MR. H. A. WATKINSON, Minister of Defence, that his dictum, expressed in his speech to Western European Union on Jne. 1, that an aggressor cannot assume that we shall be prepared to limit the war to suit his tactical plan, is at direct variance with President Kennedy's defence message to Congress, in which he said: "Our objective now is to increase our ability to confine our response to non-nuclear weapons."

Mr. Watkinson did not admit that contradiction existed or was to be implied. He said that NATO policy, as laid down by NATO and SACEUR, is being carried out exactly, and added later: "In the Government's view it is not in the interests of maintaining the deterrent to war to set out clear rules or statements which show exactly the kind of reaction one would make to any action by an aggressor."

When Mr. Watkinson stated, in answer to a question by MR. S. T. SWINGLER (Lab., Newcastle-under-Lyme), that there has been no change in the Government's policy of replying to any would-be aggressor with the appropriate degree of force, SIR L. UNGOED-THOMAS (Lab., Leicester, N.E.) asked who is to decide upon the appropriate degree of force—is it the Commander on the spot? Mr. Watkinson replied: "This is a matter first for decision in the circumstances of the time; and, secondly, General Norstad has always made it plain that he would require political authorization before initiating the use of nuclear weapons."

Arms For Germany

MR. E. SHINWELL (Lab., Easington) recurred to this issue at question time on Jne. 19 when he suggested that, as a result of four successive variations of the Brussels Treaty in favour of the Federal Republic of Germany, in respect of anti-tank, surface-to-air and air-to-air missiles (see "Air Matters in Parliament" in our Jne. 15 issue), Germany has now become the strongest military power in Europe; in consequence, he asked the Lord Privy Seal, ought not the House to be consulted before any further revision of the Treaty is made?

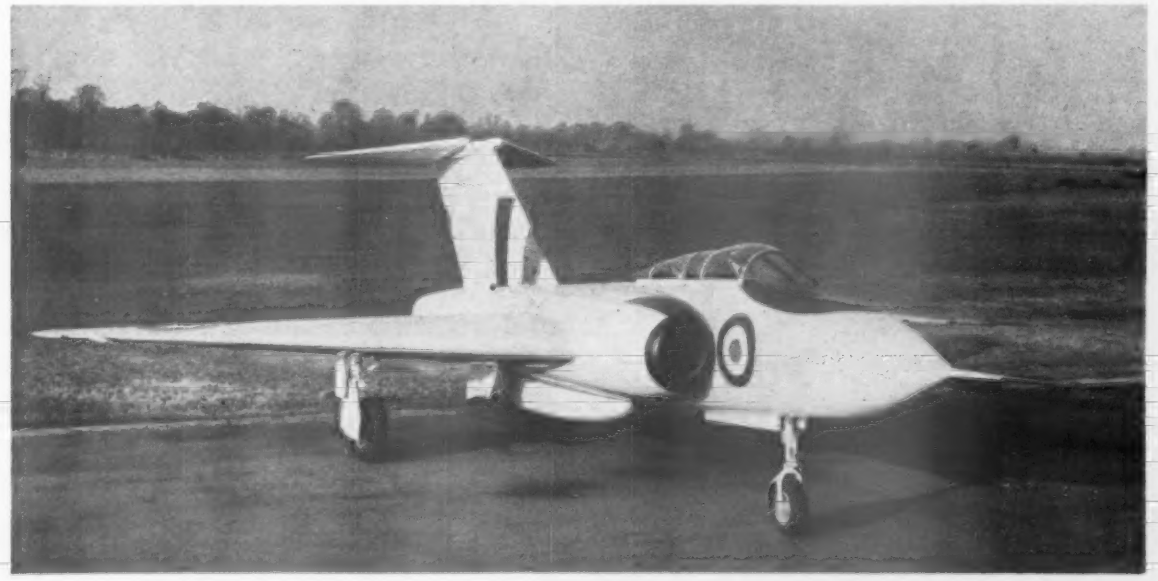
MR. E. R. G. HEATH said in reply that procedure as laid down in the Treaty confers no obligation upon the Government to secure ratification for amendments by Parliament as a whole. At the same time he could not accept that the four amendments already made have augmented Germany's military potential to the degree imputed by Mr. Shinwell.—O. W. H. COOKE.

Entering the Doppler Field

A NEW entrant into the Doppler navigation equipment field, Elliott Brothers (London), Ltd., have recently negotiated an additional licence with the Bendix Corporation to manufacture and market the latter's Doppler radar system in this country. A substantial licensee of Bendix in the aircraft communications, instrumentation and control equipment fields for a number of years, Elliotts have not produced any self-contained airborne navaids for aircraft before. They have, of course, been developing and manufacturing their own inertial guidance equipment for missile applications, for some time.

Developed by the Bendix Radio Division at Baltimore, and known as the DRA-12 Doppler radar navigation system and the CPA-24 Doppler radar navigation computer system, the equipment will be produced by Elliott's Airborne Radar and Radio Division at Boreham Wood. It has been in production in the United States for about 12 months and, although Bendix were late in entering this particular navaid field, firm orders for over 600 installations are stated to be in hand at Baltimore and approximately 200 have been delivered to civil operators and various NATO air forces.

A four-beam frequency-modulated constant-wave system designed specifically for use in transport aircraft, the DRA-12 comprises five main components and provides the usual Doppler navigator outputs of ground speed and drift angle. With the addition of the CPA-24 computer system the equipment can also provide information on miles-to-go to destination and miles left/right of selected track.



NEW LOOK JAVELIN.—Resplendent in a vivid orange colour scheme, this Javelin is to be used at A. & A.E.E. Boscombe Down as a "pacer" aircraft. Smoke generators are also fitted to make it even more visible when necessary.

OPtional Reading—1

THE aviation industry is mainly directed towards the operation of aircraft.

I was wondering how to begin this column and after some thought decided that it would be as well not to be too controversial in the opening gambit. But, having so far taken all my readers with me all the way, I would not be surprised if this beautiful unanimity will soon be undermined, first of all by individuals uttering mild dissent, then by whole groups defecting and, finally, by a great clash of opinion resulting in what will be called by the historians the OPtional wars.

So, let us ruminate amicably on this little opening platitude while we may. As a matter of fact, there is more to it than you might think. If the industry's motif is the operation of aircraft, it would be reasonable to expect the operational element to be strong both at the management level of the airlines and at the national and international regulatory level. Yet a simple survey would show that, with possibly a few exceptions among the airlines, this is not the case. The operational is, in the case of the airlines, very much subordinated to the financial and, in the case of the regulatory authorities, it is subordinated to the expert. I will probably have occasion to comment on the airline position at some future date but propose here merely to look at the regulatory position, mainly from the international standpoint. I have a natural suspicion of generalizations (born of a quarter of a century in the aviation industry?) and prefer to work with real life models. So I will take four ICAO panels, at least two of which have, I believe, never been mentioned in the technical Press.

The first (which has been mentioned) is the Vertical Separation Panel. This was set up six years ago, its main objective being to devise a new system of flight levels so as to utilize the airspace more efficiently. This was undoubtedly a laudable objective, but someone managed to get into the terms of reference an allusion to "more flight levels" (i.e., more per 1,000 ft. of vertical airspace). Now this was either an economist's idea (more flight levels available, less delays awaiting clearance and more economical cruising) or an expert's idea (if 1,000 ft. separation has been safe up to 15,000 with the DC-3 type of operation, and it has been, now that we have more accurate altimeters, automatic height locks, etc., surely there must be some extravagance in airspace by continuing the system into the jet era?). As a matter of fact, there is something in both of these arguments. But all the same, they should have been hit on the head at birth, or at any rate after the second (1957) meeting of the Vertical Separation Panel, when it became apparent that large parameters, such as static system error and flight technical error would be dominant and to a large extent irreducible. In fact, as the Panel learnt more about these and other errors, it found itself continually placing the "Investigation of ways and means of ensuring adequate and constant 'effective' vertical separation at all altitudes" (its primary objective) on the work programme of the next meeting. It then ran its discussions into the single channel of devising standard calibration procedures for altimeters and now, by a superb stroke, has got its terms of reference amended so that it doesn't have to bother its head any more about the awkward separation problem, at least not immediately.

This Panel should have had a strong OPS chairman who, every time the altimeter experts went off at a tangent, would have said: "Yes, Mr. Blacklash, but does this 10 ft. of yours amount to much when we have military (and probably some civil) aircraft sharing the airways and the flight levels with uncorrected static system errors of 350 ft. and flight technical errors of 750?" Of course, he may have run into political trouble, in which case he would have had to resign; but that would have saved the past four years of waffling.

Incidentally, this idea of taking the chair of ICAO panels by rota at each meeting is beautifully democratic, but it gravely weakens the authority of the chair and detracts from personality and individualism which is the lifeblood of a productive committee. If a study is running off the beam, the chairman, out of sheer courtesy, cannot resign at the current meeting. And he would not be in the position to resign the chair at the next because normally he would not be in it.

Another ICAO panel which for two years went off at a tangent through lack of leadership by an operations personality but which, on this occasion, eventually got back to its terms of reference was the Panel for Co-ordinating Procedures Respecting the Supply of Information for Air Operations (PIA Panel). This one you almost certainly have not heard of. Here the main object was to devise the procedures and the associated communication links necessary to ensure that a pilot could call up any station within range and get a selection of sigmet, upper wind and temperature reports as appropriate to his flight.

Now this requirement seems simple enough but, again, the issue got into the hands of the experts and, in the course of working up the subject, one of their papers "defining the problem" ran into some 200 pages! This probably put the rest of the Panel off for about 2 years—anyway, nothing much emerged in that period. However, after that interregnum, someone (I must find out who—an OPS man would be convenient to fit into my theme) did get back to the original issue and now a useful set of amendments to the COM and MET procedures has emerged.

Next week I will deal with two other Panels, the R/T Speech Panel (ever heard of it?) and the Visual Aids Panel. A study of the work and progress of these four ICAO panels will, I think, be enough to show how easily, and almost unobtrusively, able men can fritter away their time and talent once they depart from my opening theme, "the aviation industry is mainly directed towards the operation of aircraft."—C.C.J.

The A.R.B. Surveys its Year

IN the 1961 annual report of the Air Registration Board—the 24th of the series—published today, it is noted that although a year ago there were mixed feelings about the amalgamation of the companies in the aircraft industry into two or three large groups, many of the fears that existed have proved to be groundless. The threat of widespread redundancy has not materialized and the S.B.A.C. continues to report increasing production, in particular for the export market.

Reports from the Corporations and from the Independent operators indicate increasing air mileage and an increase in the number of passengers and quantity of freight carried. Demands continue for new aircraft and additions to existing fleets. All of which results in increasing work and added responsibilities for the A.R.B.

Attention is drawn to the trend in structural design away from the fatigue-prone high-strength alloys and towards the "fail-safe" philosophy. Some post-war types of aircraft, which employ a single- or two-spar wing construction using high-strength "zinc-rich" aluminium alloy, the report says, are still in operation and, as in previous years, great effort has been needed on the part of constructors, operators and the Board to avoid structural failure arising from metal fatigue. In more recent years, designers of transport aircraft have, to a large extent, discarded the "zinc-rich" alloys in favour of a lower strength "copper-rich" alloy which has remained crack-free, or in which the rate of propagation of a crack is much slower. This in conjunction with a changing design policy to the fail-safe principle in structural design, gives the Board greater confidence for the future.

The coming of supersonic and STOL—and, perhaps, VTOL—aircraft, has raised many new aspects and developments for which the Board must produce airworthiness and safety standards. Work on airworthiness problems in relation to supersonic aircraft has continued. Working groups of the Supersonic Aeroplane Airworthiness Committee have sat several times and have studied performance and handling, structures, atmospheric conditions, fuel systems, air conditioning, engine installation and flight development.

Another "coming innovation" mentioned in the report is automatic flare-out and landing—possibly leading eventually to automatic control of the whole flight. This is occupying more and more of the Board's time.

The report also has something to say about the trend towards more and more complicated equipment—which is still developing and having a considerable effect on the aircraft industry. There are great hopes that the use of transistors will lead to more robust and reliable electronic apparatus and at the same time reduce its weight, power demands and heat dissipation problems.

On the other hand these very virtues are making it worth

while to use electronic apparatus where previously it was not considered necessary. Far more electronic apparatus is thus employed than before and unless all the other features such as plugs and sockets, switching and mechanical design, can be made proportionately more reliable, a still greater load is put on air crews and servicing personnel.

The need to integrate equipment with the aircraft can hardly be over emphasized, says the report. An automatic pilot can no longer be regarded as a separately approved item installed in an aeroplane after suitable adjustment. Particularly with automatic landing in view, the auto pilots of future aircraft must be part of the comprehensive flight control system, tailored to suit the aeroplane in which it will be used.

To help achieve this, the Board has set up a committee to study the safety problems for automatic landing. A.R.B. staff also discuss with the designers, from the inception of design work, the safety aspects of the system. The first conclusion from the deliberations of those concerned is that for automatic blind landing to be acceptable for scheduled transport operations, the equipment must be such that no one fault would—from the time the pilot decides he is committed to land—interfere with a safe auto-landing without any emergency action by the pilot.

Other points made in the report are that the Ministry of Aviation is considering the delegation to the Board of the task of type approval of airborne radio apparatus. With the rapidly increasing use of radio components in controlling aircraft systems the Board believes that much would be gained if responsibility for all aircraft systems were vested in one organization. It has also been agreed that the A.R.B. should examine and licence radio maintenance engineers.

On the subject of private and executive flying, the report expresses the Board's support in the desire of all concerned to expand business, executive and private aviation in this country. Every effort, it says, will be made to ease the burden of the private owner; and discussions are also proceeding to simplify the regulations applicable to flying clubs.

Draft requirements suitable for aeroplanes of less than 6,000 lb. all-up weight are in an advanced stage of preparation. Hitherto such requirements have been in Section D of the B.C.A.R.s and there has been a general wish within the industry for light aircraft to be treated separately. The new draft aims at maintaining the same level of airworthiness as in the past, but with the simplification of requirements whenever possible. It is also intended to ensure automatic compliance with the corresponding U.S. requirements.

The Ministry of Aviation has accepted the A.R.B.'s proposals for the introduction of a U.K. C. of A. for Export, and the document can now be issued in respect of new or used aircraft exported from this country.

During the past year some 12 turboprop, one turbojet and three piston engine types have been approved. In many cases the constructors sought F.A.A. certification also, and this has been obtained in all cases.

The period between overhauls of British gas turbines has been steadily increasing. No less than 3,000 hr. has now been established as the overhaul period for one type of turboprop engine; this is believed to be the highest figure approved for any engine in operation.

It is reported, though, that no satisfactory conclusions have been reached yet in the negotiation with the F.A.A. regarding a modern method of rating for helicopter turbine engines.

India's Supersonic HF-24

FOLLOWING the preliminary brief news that the Hindustan HF-24 supersonic fighter, powered by two Bristol Siddeley Orpheus turbojets, had made its first flight—as recorded in our Jne. 29 issue—further information has come from India concerning this most interesting aircraft.

Specifically intended to meet the requirements of the Indian Air Force, the HF-24 is primarily a fighter but has also been designed with a wider "all-purpose" application in mind. It is said to incorporate many advanced aerodynamic concepts to make it safe and easy to fly at low speeds as well as at high speeds in the region of twice that of sound. These slow-speed characteristics have been thoroughly explored in the wind-tunnel at the Indian Institute of Science at Bangalore.

Certainly the new fighter is in the modern fashion with highly swept, very thin wings; a needle nose; and an area-ruled fuselage. It is equipped with a zero-height ejection seat. The powerplant selected for the HF-24 is two Orpheus 703, each of which gives a thrust of 4,850 lb.; this engine is very similar to that used for the NATO Fiat G-91s.

Nearly 50% of the components embodied in the HF-24 are made in India. Construction of the airframe is centred at the Hindustan Aircraft Factory at Bangalore where, too, the Orpheus is being manufactured under licence from Bristol Siddeley. Hindustan Aircraft has announced that its plans for series production of the aircraft are well advanced. And the Indian Defence Minister, Mr. V. K. Krishna Menon has disclosed that the performance of the HF-24 would be developed further by fitting the aircraft with more powerful engines. In fact, he has expressed the view that in a few years India "will be independent of foreign service, provided our technical developments also progress simultaneously."

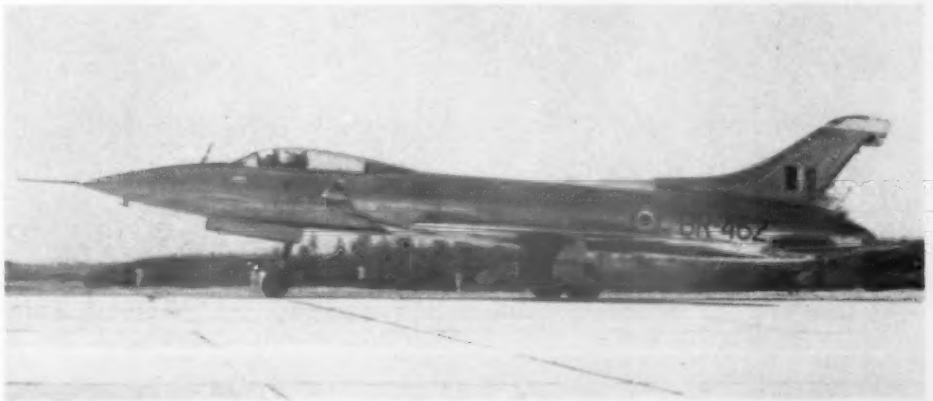
The maiden flight of the HF-24 was in the hands of Wg. Cdr. Suranjan Das and lasted for 20 min. It was witnessed by Mr. Krishna Menon who described it as a "memorable event" and congratulated the designer, Kurt Tank, and his team. The production of the HF-24 shows, he said, that given suitable opportunities the country could accomplish even seemingly impossible things and build its future with its own hands.

News from Luton

HAVING had occasion to pay frequent visits to Luton Airport recently, a correspondent writes that he has been impressed by the activity at that airfield—which, he says, must be the least appreciated airport within 30 miles of London. He goes on:—

"VTOL and STOL seem to be the order of the day at Luton, with Huntings developing something exotic in that line, and Ken Cartwright of Napiers rushing around in a diminutive helicopter which appears to be a variant of the Bensen Gyrocopter. This incredible little machine gives the appearance of being very manœuvrable and lively, and certainly produces a vast volume of noise from its two-stroke power unit. It must be very draughty for the driver, however."

Since our correspondent sent us this note, it has been made known that the little helicopter he mentions, is one designed as a joint venture by Napier and Pan Britannica Industries. It is intended specifically for crop spraying and as an agricultural aid within the means of the small-acreage farmer.



INDIAN FIGHTER.—The slim lines of India's new Hindustan Aircraft HF-24 supersonic fighter are shown to advantage in this side view of the aircraft which made its first public appearance on Jne. 24.

Aviation News in General

POWERPLANT CHANGE.—So that experience may be gained at speeds more representative of those at which commercial hovercraft will be operated the SRN1 has now been fitted with a Viper turbojet replacing the Maboré with which it has been fitted since April, 1960. The Viper's thrust of 1,500 lb., an increase of 700 lb. over the Marboré, will give the SRN1 a maximum speed of 65 knots. This machine has now logged more than 250 hr.

AVRO 748 ABROAD.—On Jly. 3, the second Avro 748 (G-ARAY) was to leave for Cyprus, where tropical trials are being undertaken. They will continue next month at Torrejon, near Madrid.

MET. RADAR.—The Government has placed orders for five Decca windfinding radars and one weather radar for deployment along the Ankara-Tehran-Karachi air route. The equipment is being supplied under the U.K. programme of technical assistance to the regional countries of the Central Treaty Organization.

ASTAZOU UPRATED.—The take-off power of the Turboméca Astazou turboprop has been uprated to 561 h.p. Formerly certificated at 470 h.p., the Astazou now has a maximum continuous shaft power of 480 h.p.

BUTLIN HELIPORT.—A plan to build a heliport at the Butlin Holiday Camp at Filey, Yorks, has been approved by the East Riding County Council.

TRI-MOTOR.—Flight testing of Canadian Pratt & Whitney's PT6 500 h.p. free-turbine installed in the nose of a converted R.C.A.F. Beech Expeditor has begun at St. Johns, P.Q.

to be uprated from 630 to 700 h.p. Since its initial transition flight in 1958 the Vertol 76 has made 273 conversions.

CREDIT WHERE DUE.—In the report of the air display at Yeovilton in our Jne. 22 issue, No. 899 Squadron was wrongly credited with the aerobatic team of Sea Vixens. These aircraft were, in fact, from No. 766 Squadron of the Naval Air Fighter School.

EUROSPACE PLANS. — Working parties have now been established within "Eurospace"—the European Industrial Space Study Group formed in Paris on May 29—for the purpose of examining and evaluating possible programmes, projects and budgets. This was announced by Hawker Siddeley Aviation during last week's European Space Flight Symposium in London.

IN SERVICE.—Dassault Mirage IIIC interceptors are now in service with the Dijon squadron of l'Armee de l'Air, after pilot training at Mont-de-Marsan. This line-up of 16 also includes some pre-production Mirage IIIAs.

VTOL RESEARCH.—Further development of the Vertol 76 tilt-wing research aircraft is assured by a $291,000 contract awarded by the U.S. Army. Its wings are to be modified to improve stability and control during descent. Transmissions are

SCOUT FAILS.—A four-stage Scout rocket launched from Wallops Island on Jne. 30 failed in an attempt to orbit a 187-lb. satellite designed to record the impact of meteorites. The third stage exploded at a height of about 70 miles.

X-15 REVISION.—The record speed of 3,690 m.p.h. stated to have been achieved by Maj. R. White in the North American X-15 on Jne. 23 has been "derated" by NASA to 3,603 m.p.h., "following a detailed analysis of radar flight data."

MOON BUDGET. — President Kennedy's budgetary requests for manned spaceflight—amounting to $1,784,300,000 (approx. £625m.)—were approved by the Senate on Jne. 28. The Bill lays the groundwork for the Lunar Exploration Program which is expected to cost up to $9,000,000,000 (some £3,214,000,000) in five years.

SKYBOLT TESTS.—A Vulcan Mk. 2 bomber has arrived at Edwards A.F.B., California, for the purpose of checking the compatibility of the Vulcan and Skybolt ALBM electrical systems.

ATLAS EXPLODES.—An advanced Model E Atlas I.C.B.M. exploded some two minutes after launching from Cape Canaveral on Jne. 22. It had been aimed at a target 7,300 miles away in the South Atlantic east of the West Coast of Africa. There was no deliberate attempt to "destruct." Another Atlas E exploded after being launched from a Hollywood-Hard semi-protected site at Vandenberg A.F.B. on Jne. 7.

—AND TITAN.—A two-stage Titan I.C.B.M. blew up after ascending through low cloud over Cape Canaveral on Jne. 23. The re-entry head was to have travelled 5,000 miles during testing of a lightweight inertial guidance system for the advanced model Titan II. In this, trajectories applicable to several targets are "memorized," giving the launching officer a press-button choice of destination.

Commercial Aviation Affairs

UNITED CARAVELLES.—On Jly. 14 (French Independence Day) United Airlines will put its first Caravelles into service between New York and Chicago, with a frequency of three round trips a day. The aircraft are in an all-first-class lay-out with 64 seats. The first Caravelle was accepted at O'Hare Field, Chicago, on Jne. 20 and delivery of all 20 is to be completed by January, 1962.

T.W.A. ASIAN AMENDMENT.—T.W.A. is seeking C.A.B. authority to cease serving Bangkok and Colombo on its route beyond India. Both are described as unsatisfactory route terminals, and T.W.A. wishes to suspend operations from Aug. 1 until it can extend the route to Hong Kong. The latter extension depends on permission from the C.A.B. and the British Government.

BOEING PROSPECTS.—A Boeing commercial team in the Middle East is reported to have discussed possible sales to several airlines in the area, including United Arab (interested in 707-320Bs), Trans Arabian (considering two 720Bs), Saudi Arabian (discussing four 727s, including one for the Royal Household), Iraqi Airways and Iranian Airways.

FORTY-FOUR CERTIFICATE.—Full type certification for the Canadair Forty-Four was issued by the Canadian Department of Transport on Jne. 29, six and a half months after the first flight of the swing-tail version ordered by Seaboard World, Flying Tiger and Slick.

NAVIGATION TESTS.—The flight test which, from Aug. 1, is required by the Ministry for the grant of a Flight Navigator's licence will entail about eight hours of in-flight navigation outside extensive airway networks and must include a continuous period of five hours or a distance of 1,000 naut. miles.

AIR CARGO STUDY.—A comprehensive study is being made by B.O.A.C. of the future of air cargo as it affects the Corporation. Final recommendations are expected in a year. The study is being made by "task forces" of B.O.A.C. executives, aided and guided by Mr. Heinz J. Heinrich of Heinrich Aviation Consultants, Ltd., Montreal. Subjects covered include market research, aircraft evaluation, ground handling procedures and equipment, integration with other transport operators, and the part to be played by freight.

LANDING STORY.—A study is being made by the F.A.A. of jet transport landing characteristics. A theodolite camera is being used to photograph routine landings at Chicago, Baltimore, San Francisco, Denver and Dallas, to obtain information on average angles of approach, rates of descent, touch-down spots and deceleration rates.

PAKISTAN NAVAIDS.—The United States has presented Pakistan with a DC-3 equipped with test and recording equipment for the airborne calibration of VOR, ILS and other navaids.

MANILA MODERNIZATION.—The U.S. Export-Import Bank is authorizing a $5 million loan to the Philippines for the modernization of Manila International Airport. It will be used for the purchase of electronic and mechanical equipment.

AIRSAF INCREASE.—Air Safaris, Ltd.—now operating under the name Airsaf—has increased the frequency of its Hurn-Dublin-Belfast services from two to four a week, using 36-seat Vikings.

DOPPLER VOR.—The first Doppler VOR has been commissioned by the F.A.A. at Marquette, Mich., and the second will come into use at Rikers Island, New York, next month. Doppler VOR installations, which are compatible with existing aircraft VOR receiving equipment, are being made at a a number of sites where VOR performance is poor.

ACCIDENT REPORT.—The report of the commission investigating the crash of a Finnair DC-3 last January, says that neither the pilot nor the co-pilot was in a fit condition to fly because of the effects of alcohol and lack of sleep. Both had spent much of the night before the crash at a party. The immediate cause of the accident was loss of power when a turn was initiated at too low an altitude.

ARGENTINE CRASH.—A Curtiss C-46 Commuter of Transcontinental S.A. crashed on Jne. 30 two miles short of the airport at Buenos Aires. There were 12 survivors among the 31 passengers and crew of four.

CARLISLE OCCASION.—On Jne. 15 the airfield at Crosby-on-Eden was formally opened as Carlisle's municipal airport. Cumberland Aviation Services (Casair) is resident at the airport and provided the Rapide from which the Mayor performed the opening ceremony. Left to right here, are: Mr. H. Fawcett and Mr. N. Atkinson of the airport committee; Mr. J. M. Kidd, managing director of Casair; Capt. N. Hancock, pilot; Mayor T. L. MacDonald; Mr. W. H. Lakeman, the chief constable; and Mr. H. Glaister, deputy chairman of the airport committee.

News About People

BACK WITH A.W.A.—After serving on the international sales staff of Hawker Siddeley Aviation, Ltd., as North American representative for the Argosy and Avro 748, Mr. R. E. LeLong has rejoined Armstrong Whitworth Aircraft, Ltd., this time as general sales manager.

EUROPEAN APPOINTMENT.—Mr. James L. Stuart, former director of the F.A.A. Bureau of Research and Development and one-time president of Lear, Inc., has been appointed manager of European operations for Chance Vought Corporation. He will make his headquarters in Paris.

AERO GOLF. — Winner of the Brabazon Trophy at the Aero Golfing Society's President's Invitation meeting at Huntercombe on Jne. 23 was D. Parker with F. G. Taylor runner up. L. H. N. Bickmore and D. H. Steel won the afternoon two ball foursome competition. A. Gough and J. Cuming were runners up.

PRODUCTION SUPERVISOR.—Newly appointed director for production for the Goodyear Tyre and Rubber Co. (Great Britain), Ltd., is Mr. Arthur Ruston who succeeds Mr. J. Q. Shaul.

MLLE HELENE DUTRIEU.—It is with regret that we record the death of Mlle Hélène Dutrieu, one of the first women pilots to hold a flying certificate, who died on Jne. 26. Qualifying in August, 1910, her first flight was on a Demoiselle of M. Santos-Dumont. Before World War I she won many awards for speed, altitude and endurance feats.

DENHAM VISITORS.—Nine officers of the French Armée de L'Air and one officer of the Aéronavale visited the Denham factory of the Martin-Baker Aircraft Co. recently to familiarize themselves with the latest ejection seats installed in their Mirage and Etendard aircraft.

Air Transport

Flying at 2d. a Mile

OFF-PEAK winter fares between London and Scotland at the rate of 2d. a mile have been planned by B.E.A., subject to A.T.L.B. approval. They are believed to be cheaper than any fare available on scheduled services anywhere in the World. Available on one late evening flight daily in each direction between Edinburgh and London via Glasgow, the fares are 63s. single or 126s. return, which is less than the present standard second-class rail fare. Cheaper fares are available on some railway excursions.

The service is to be operated from Nov. 1 by 139-seat all-tourist Vanguard V.953s, and the cheap fares have been made possible only by the introduction of this type of aircraft and, in particular, its large freight-carrying ability. On the London-Glasgow-Edinburgh route, enough freight is expected to be available to support these low fares even without full passenger loads being achieved.

Although B.E.A. domestic services as a whole still incur a loss (about £700,000 in 1960) the London-Edinburgh and London-Glasgow routes became profitable in the middle of 1959 and, together with those to Belfast and Manchester, are now making a reasonable profit. The new fares are part of B.E.A.'s continuing development of these domestic trunk routes, on which there has been something of a traffic "breakthrough" since 1959. In the 1961/62 financial year, the number of seats on the Glasgow and Edinburgh route is being increased from some 500,000 to 800,000 and by 1963-64 the total is planned to be over 1,200,000.

Lord Douglas announced last week that the B.E.A. profit for the 1960/61 year is £1,540,000, after payment of £1,300,000 interest on capital. This is substantially more than the figure which had earlier been provisionally forecast.

Performance of the Boeing 320B

ORDERS for the Boeing 707-320B have been announced in recent months by both the major U.S. international operators, Pan American and T.W.A. More details of the performance of this "growth" version of the 707-320 Intercontinental have now been revealed. Physically, it differs from the basic -320 in having 18,000 lb.s.t. JT3D-3 turbofans, new wing leading and trailing edge flaps and low drag wing-tips.

With equivalent payloads to the -320, the -320B will fly 20% farther; 4,400 naut. miles instead of 3,600 naut. miles with a maximum of 186 passengers and full cargo payload. For equivalent ranges, 20,000 lb. more payload can be carried. The new gross weight is 317,500 lb.

The CAR field length required at max. weight (sea level, 86°F.) is 10,000 ft., or some 2,000 ft. less than that for the existing -320 at its maximum weight of 315,000 lb.

The programme of drag reduction and aerodynamic clean-up on the -320B not only contributes to the improved range performance but also reduces costs. The direct operating costs (1960 ATA with maintenance burden) are estimated by Boeing to be $2.1 per aircraft nautical mile at a range of 3,500 naut. miles, or some 8 cents better than the basic -320 figure.

First flight of the -320B is scheduled to take place in January 1962 and deliveries will begin in the Spring.

The Struggle for European Routes

HEARINGS by the Air Transport Licensing Board on European route applications, which began on Jne. 20 (see our previous issue, p. 743) continued last week on Jne. 29 and 30, and were to resume again this week on Jly. 4, as this issue closed for press. The two days last week were taken up by a continuation of the opening phase of the hearings, consisting of general statements in support of applications by B.E.A., B.U.A., Cunard Eagle and Tradair; cross examinations of witnesses about these applications; and a general statement by B.E.A. on the grounds of its objection. The second phase, expected to be started yesterday, Jly. 5, will consist of individual route applications for European destinations, and will be followed by the third phase dealing with domestic routes.

When the hearings resumed last Thursday B.E.A. spent some time challenging the traffic statistics and forecasts put in by B.U.A. In general, however, there is no great disagreement between B.E.A. and the independents on the estimated traffic growth in Europe for the next few years. The fundamental question, as we reported last week and as was again made clear in statement and counter-statement by the protagonists, is whether dual participation by British operators on European routes is right and, if so, what its likely effect will be on the operations of B.E.A.

A number of witnesses appeared in support of the general case for the independents. Among them was Mr. F. A. Laker, executive director of B.U.A., who expounded on his company's plans to develop Gatwick and to build an Air Terminal over the railway tracks at Victoria Station. The latter is to be built regardless of the outcome of the present applications, and will be available for use by other companies if they wish.

B.U.A. claims that the use of Gatwick for its proposed network of European services would provide a better service to the public and would attract to air travel people living over a wide area of Southern England. This view was contested by B.E.A., which believes that the great majority of traffic from Heathrow, Gatwick, Southend, Manston and Lympne is all Greater London traffic and regards them all as London airports.

For Tradair, Mr. Porter enlarged on his company's plans to provide scheduled services only for group bookings by travel agents and tour operators, at ITX (IATA-approved) fares. This scheme, which has to have an A-class licence but will not be advertised to the public as a normal scheduled service, seems to be well regarded by other parties in the case, and even B.E.A. congratulated Tradair on "trying to make its own cake" in contrast to the other independents' "beggarly attitude of taking crumbs from the rich man's table."

In stating its general objections to the case, B.E.A. brought its big guns to bear. B.E.A., said Mr. Marking, leading the case, believes it is in the best interests of British civil aviation that the Corporation be allowed to continue along the lines it has pursued for 15 years with considerable success.

The independents' applications, with 15 airlines making over 200 objections to each other, was a "greedy scramble for the plum routes" and the "horse-trading" between B.U.A. and Cunard Eagle showed that what they wanted was not really competition but a protected share of somebody else's business. "They want," said Mr. Marking, "privilege without obligation, profit without the purchase price." The applications were an attempt by the shipping lines to extend their activities to the air for their own benefit.

This point was taken up and underlined by Mr. Milward, who presented a capsule survey of B.E.A.'s past achievement, present position and future plans. The purpose of his evidence was to show that:

The airline business in Europe is already highly competitive. Introducing more operators will not increase the traffic or the standard of service.

B.E.A. is one of the very few airlines in the World making money, but its business is balanced on an economic razor's edge.

Approval of the applications would mean much more economically to B.E.A. than a division of effort. The applications have only been made for profitable routes.

To slow down B.E.A.'s planned growth would have grave economic consequences.

In his questions to Mr. Milward, Mr. Gardiner, Q.C., for B.U.A., again dwelt upon inter-government bilateral agreements and inter-company pool agreements. Mr. Milward stoutly defended B.E.A.'s pool agreements, but agreed that the Corporation would welcome a free trading situation without the restriction of bilateral agreements.

Further evidence on this point was given by Sir George Cribbet, who was responsible, as the deputy director general of civil aviation and later as deputy secretary at the M.C.A. until 1956, for the inter-government aspects of civil aviation. Between 1946 and 1955, 15 European bilateral agreements were concluded by the U.K., and in every case, Sir George explained, only one airline was designated by each European country to serve the routes to the U.K.

So-called "predetermination" agreements, such as those with France, Greece and Portugal, specified equal sharing of capacity by the airlines of the two countries. The Bermuda-type agreements substituted the phrase "fair and equal opportunity for the carriers of two nations," but European governments did not interpret this as permitting any significant departure from an equal sharing of capacity. Sir George was of the opinion that no European government would countenance dual participation by British operators unless the traffic of the second operator came out of the B.E.A. share of the total.

This whole question of bilaterals is, clearly enough, of the most importance in this case, and in his cross examination of Sir George, Mr. Gardiner again suggested that the U.K., which generated so much tourist traffic for European countries, should take a more resolute line over its bilaterals.

Order of Excellence?

What are the qualities that a buyer looks for in a light executive/touring aeroplane? Reliability, comfort, economy, performance, good looks? And in what order?

Whichever way you look at the new BEAGLE AIREDALE it scores well. It is comfortable, quiet and has good furnishings; it has a rugged airframe and a dependable engine. It has all-weather equipment for day and night flying. It is inexpensive to buy and it is attractively cheap to operate. It has a vivid performance with outstanding range capability. And it is elegant. **The AIREDALE is good business—and it is British.**

QUALITY — PERFORMANCE — ECONOMY

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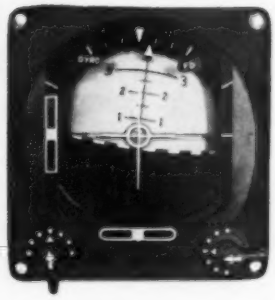
BEAGLE BRITISH EXECUTIVE AND GENERAL AVIATION LIMITED **BUY BEAGLE — BUY BRITISH**

C

Left: Capt. J. A. Cameron, Manager BEA Helicopter Unit. Right: Mr. J. S. King Asst. Manager, Aero Sales, Sperry.

SPERRY answers the Helicopter's need

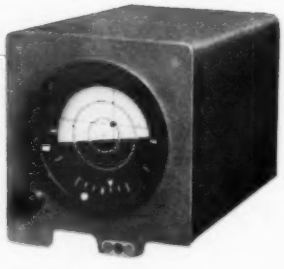


Four-Axis Spherical Director Horizon

BEA and SPERRY are together tackling the development of all-weather instrumentation without which full-scale passenger-carrying operations on a commercially paying basis will not be possible. The first hardware to result was a logical extension of conventional techniques based on the two-axis Zero Reader flight director pioneered by Sperry for fixed-winged aircraft, but now incorporating two extra indices for tail rotor and collective pitch.

The next logical step was to present the four-axis information against background attitude, using either a spherical presentation divided horizontally into dark and light areas, or a roller-blind presentation similar to that specified for the Trident.

Helicopter instrumentation is only one of many aspects of Sperry's aeronautical work. The Company is also currently engaged on navigation, guidance and control problems for VTOL and fixed-wing aircraft. These offer long-term interest to electronic and electro mechanical engineers and designers, on stable platforms, auto-stablisers, auto-pilots and instrumentation. If you feel you would like to play a part in



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Air Transport . . . .

IBERIA, Airlines of Spain, introduced jetliner service to New York on Jly. 1 with Douglas DC-8s. The Spanish airline has three of the Series 50 version of the DC-8 equipped with Pratt & Whitney JT3D-1 turbofan engines.

A Change in Jordan

AIR JORDAN, the local and regional operator in Jordan, is to be dissolved and succeeded by a new company, Jordan National Airways, with a capital of one million dinars. The major shareholdings in Air Jordan will be transferred to the new company, together with most of the existing personnel.

The original Air Jordan Co., Ltd., was founded in 1950, and was merged in 1958 with Arab Airways (Jerusalem), Ltd., to become Air Jordan of the Holy Land. Transocean Air Lines has a financial interest and was under contract to manage the airline; it is not clear from present reports whether this contract is to be continued. According to reports from Jordan, an Air Jordan DC-4 and DC-3 were recently impounded at Beirut following action by Esso to recover a $350,000 debt.

Caribbean Air Services

DELEGATIONS representing the West Indies, the United Kingdom and the United States have reached provisional agreement, subject to Governmental ratification, on additional air services in the Caribbean. To meet the urgent demands of the West Indies for additional routes to serve its expanding tourist industry, the U.S. has been given the right to operate the New York-Jamaica and Atlanta-Jamaica routes. A route between Antigua and New York is granted to the U.K. until the West Indies achieves independent status, on May 31, 1962. At that time it will become a route for the West Indies (see our issue for Jne. 22, p. 718).

This arrangement will continue until Oct. 1, 1962, and is subject to further extension by mutual agreement of the West Indies and the United States. The delegations were headed by the Hon. W. Andrew Rose, Minister of Communications and Works, the West Indies, Mrs. Alison Munro, Under Secretary for Aviation Overseas Policy in the United Kingdom Ministry of Aviation, and Mr. Ernest Lister, Deputy Director of the Office of Transport and Communications, U.S. Department of State.

S.A.S. Accused

BOTH Pan American and T.W.A. have now filed complaints with the C.A.B. accusing Scandinavian Airlines System of violating the agreement under which it operates services to and from the U.S. Similar complaints against K.L.M. were discussed in our previous issue.

The charge is that S.A.S. services across the Atlantic have been planned and are operated primarily for the carriage of traffic between the U.S. and countries other than Sweden, Norway and Denmark. The U.S. airlines also complain that S.A.S. frequencies across the Atlantic "grossly exceed" the traffic demands between the three Scandinavian countries and the U.S.A.

Costs of the One-Eleven

AMONG the data prepared by British United Airways to support their case before the A.T.L.B. for scheduled service licences in Europe is a breakdown of operating costs for the B.A.C. One-Eleven. The British Aircraft Corporation has already made the point that this short-haul jet aircraft has economics better than those of the Viscount (see our issues for May 11 and Jne. 22); this claim is now substantiated by B.U.A. in estimates related to its own routes and compared with its own experience of the Viscount. The gross weight of the long-range version of the One-Eleven, which B.U.A. is expected to obtain, is quoted as 73,500 lb. compared with the basic weight of 68,250 lb.

B.U.A.'s requirement for 10 aircraft assumes that the present scheduled services (excluding Central and East Africa and allowing for a 14% growth rate per annum) will represent 58.7 million passenger miles a year in 1965; services operated for Sudan Airways account for 29 million passenger miles and a similar allowance is made for long-term contracts and Air Ministry trooping. To this total of 116.7 million passenger miles is added 154.6 million for the new European routes applied for, to make a grand total of 271.3 million.

Each One-Eleven is estimated to produce 29 million passenger miles per year, requiring a fleet of 10 aircraft for the estimated traffic. From these calculations it appears that only four, or at most five, aircraft would be required if none of the new route applications are successful.

Hourly operating costs per aircraft for a fleet of 10 aircraft in 1965 are estimated at £284.4, compared with the £192.2 for the present fleet of Viscounts. These costs break down as shown in the accompanying table. On this basis, the cost per available seat mile is between 2.83d. and 3.05d. depending on utilization and accommodation. As the second table shows, the break-even load factor is around 50% to achieve a 7½% profit on turnover at a typical European revenue rate of 6.25d. per passenger mile.

	VISCOUNT (Present Fleet)	B.A.C. One-Eleven (10 Aircraft) Projected Cost Level 1965
	£	£
Depreciation, insurance and interest on capital	35.9	67.3
General overheads	24.5	31.0
Sales promotion, advertising and commissions	27.0	39.6
Outstations	3.6	4.5
Maintenance	32.5	35.0
Aircrew (including cabin staff)	19.0	24.0
Passenger catering	8.4	12.0
Fuel	18.8	35.0
Landings	14.5	20.0
Handlings	8.0	16.0
Operating cost per hour	£192.2	£284.4

	VISCOUNTS (Present Fleet)	B.A.C. One-Eleven (10 Aircraft) Projected Cost Level 1965	
Annual utilization per aircraft	2,500 hr.	2,150 hr.	2,000 hr.
Seating capacity	64	64	69
Block speed, m.p.h.	230	350	350
Cost per available seat mile	3.13d.	3.05d.	2.83d.
Estimated revenue yield per passenger mile	6.25d.	6.25d.	6.25d.
Break-even passenger load factor	50%	48.8%	45%
Rate per hour to include 7½% profit on turnover	£206.6	£305.7	£305.7
= per available seat mile	3.37d.	3.27d.	3.04d.
Passenger load factor required to break even and earn 7½% profit on turnover at 6.25d. per passenger mile	54%	52%	49%
On the basis of a 60% passenger load factor and a seat mile cost including 7½% profit the revenue yield per passenger mile (i.e., fares to the public) could be reduced by	10.1%	12.8%	18%

Air Transport . . . .

Riddle's Argosy Utilization

FIVE of the seven Armstrong Whitworth Argosies for Riddle Airlines have now been delivered and the other two are to be flown across the Atlantic later this month. In recent weeks, Riddle has been achieving nearly 10 hours a day utilization with two Argosies on the Logair contract, with a third aircraft achieving about four hours a day on crew training. The fourth and fifth Argosies were delivered in the second half of June and have now gone into service.

The Logair contracts, involving daily flights round groups of U.S.A.F. bases in the Eastern U.S. to move outsize cargo items, call eventually for a utilization of not less than 4,000 hours a year with each aircraft, and Riddle hope to achieve 13 hours a day by September. This very high utilization calls not only for precise flying, but also for quick turn-rounds and a first-rate after-sales service. Loading and unloading at the U.S.A.F. bases is not Riddle's responsibility, and in most cases has been contracted by the U.S.A.F. to civilian agencies. Despite the obvious difficulty of decentralized control which can result from this system, turn-round times as short as 12 minutes are being achieved, thanks largely to the Argosy's front and rear loading.

The five aircraft at present in the U.S. are subject to an Airworthiness Directive calling for daily inspection of the tail unit for local cracking of the skin. This follows the introduction of a temporary modification which was made soon after the first three aircraft had been delivered to Riddle. Cracking was caused by aerodynamically induced vibration at the fin/tailplane junction and led to the aircraft being grounded for three days until the temporary modification was introduced. The other two Riddle Argosies will have a final modification and Armstrong Whitworth will send a working party to the U.S. later this summer to modify the other aircraft.

The way in which this particular snag has been handled, and the after-sales service for the Riddle Argosies in general, provides a good example of the importance the Hawker Siddeley Group now places on this aspect of civil aircraft sales. The fact that the supply line is 4,000 miles long and that Riddle are the first Argosy users has not made things easier, but Armstrong Whitworth have come to grips with the problem of supplying, repairing and overhauling the equipment of more than 100 suppliers used in the Argosy, as well as the airframe itself.

More than £1 million has been invested in spares by A.W.A., and arrangements have been made for many parts to be obtained by Riddle from the de Havilland Inc. (now Hawker Siddeley) stores in New York and from the Vickers Inc. (now B.A.C.) stores in Washington. The de Havilland store handles the products of 33 British companies; Vickers Inc. supplies Riddle with spares associated with engine and airscrew equipment made by 11 companies, while another 17 companies, including seven American, supply Riddle direct.

Repairs and overhaul involve, in addition to Riddle Airlines itself, 11 companies in the U.S. and Canada, some of these being the American associates of British manufacturers (e.g., Normalair (Canada), Ltd., and Godfrey Engineering Co., Ltd., of Montreal) while others have special arrangements to handle the British equipment (e.g., Hamilton Standard for Rotol propellers, Dallas Airmotive for Rotax and PacAero Engineering for Napier).

Line maintenance of the Argosies on Logair flying is undertaken by Riddle at Tinker A.F.B., the terminus of the Logair routes.

Secondary Radar Trials

OPERATIONAL trials of the first secondary surveillance radar system in the United Kingdom have now started at the Southern Air Traffic Control Centre at London Airport (Heathrow). Employing equipment manufactured by Cossor Radar and Electronics to M.o.A. specifications, this experimental installation is being used to gain operational experience in the application of secondary radar in civil A.T.C. and for determining the siting and maintenance requirements.

These objectives should be reached within about 12 months and this new ground control service will then become fully operational. When this happens it will be mandatory for all civil aircraft to carry a secondary transponder in order to fly in designated areas above a specified minimum altitude. Initially, this will probably be of the order of 25,000 ft., to be lowered subsequently as and when ground and aircraft equipment programmes permit.

At present limited to the one sector covering Airway Green One, the service will also be extended to cover other areas of the U.K. airspace. For this, a total of seven or eight dual secondary radar installations will be required. Each installation should have an all-weather range of about 180 n. miles for aircraft at 30,000 ft., with a maximum operating height of 60,000 ft.

In a secondary radar system a ground interrogator-responder generates interrogation signals which are received and replied to by a transponder-equipped aircraft in coded form for eventual display on an A.T.C. PPI presentation. Four modes of interrogation (A, B, C and D) are at present provided, and the airborne transponders can transmit one of 64 combinations of six "information" pulses in reply. There is also a special aircraft identification pulse which can be transmitted by manual control on request from the ground controller.

It is possible for the side-lobes as well as the main lobes of the system to interrogate the aircraft so that several responses from one aircraft can appear on the primary radar display; side-lobe suppression facilities are now considered essential by both the M.o.A. and the U.S. Federal Aviation Agency. The original ICAO requirement, adopted by the M.o.A., is for a two-pulse side-lobe suppression system on interrogation mode B; but the F.A.A. have proposed an additional three-pulse side-lobe suppression system for incorporation on mode A.

This means that all civil aircraft wishing to use the S.A.T.C.C. experimental services, and, later, to fly within the proposed mandatory U.K. secondary radar controlled air space, initially need to carry a transponder capable of two-pulse side-lobe suppression on mode B. Operators flying over the United States will need to adopt the new F.A.A.-proposed requirement for three-pulse suppression on mode A. Cossor's two-pulse transponder can be modified to provide three-pulse operation on mode A, and the M.o.A. two-pulse ground interrogation system will, in time, be modified to provide three-pulse operation on mode A as well.

In addition to aircraft identification and tracking facilities provided by secondary radar, automatic transmission of height information from aircraft to ground is possible, and feasibility trials in this direction are to start at S.A.T.C.C. within the next few weeks. This technique employs the "gating" of a particular aircraft secondary radar echo on a PPI display by means of a "joystick" control. The automatic transmissions taken from a modified Smiths servo altimeter are then transmitted in digital form to the controller's console for presentation by counters.

The S.A.T.C.C. secondary surveillance radar installation at London Airport includes this mobile interrogator-responder unit sited in the centre of the airfield. The equipment was built by Cossor to M.o.A. specifications.

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Air Transport . . . .

One Airline's Growing Pains

RECENTLY published statistics for Alitalia's operations during the first two months of 1961 are interesting in themselves and because they have been made the subject of a detailed analysis—by Ing. Bruno Velani, Alitalia's director-general—which has been published in *Freccia Alata*, the company's magazine.

Alitalia's current expansion programme started in the summer of 1960 with the introduction into service of DC-8s and Caravelles. Although the re-equipment will not be completed until 1962, a very considerable proportion of Alitalia's fleet has now been replaced with jets and new aircraft will continue to be delivered at regular intervals through this year and next. At the end of April this year the turbine fleet consisted of four DC-8s (with six more on order) and six Caravelles (with eight on order).

It is notorious that statistics, however factual they may be, are capable of being differently interpreted by different specialists and the director-general of an airline is not, necessarily, the most detached critic of his own company's figures. Ing. Velani's analysis of Alitalia's present situation, however, is, in fact, a very sober and realistic report and contains a clear warning of the dangers and difficulties inherent in an over-rapid expansion programme.

Ing. Velani first draws attention to the greatly increased capacity offered—an increase of 49.1% in ton-miles over the same period in 1960, and an increase of 42.3% in seat-miles offered. He points out that a more gradual increase in capacity would have been preferable, in order to allow an easier absorption of the increase. Even better, he writes, would have been an increase in the load factor. The characteristics of the new aircraft introduced into service and the nature of the competition being faced by the company did not, however, permit either.

This increase in offered capacity is, of course, the direct result of the greater capacity of the DC-8 and the Caravelle by comparison with their predecessors. It has not been possible,

Societa Aerea Mediterranea is now operating three ex-Alitalia DC-6Bs on inclusive tours and general charters in Europe. Alitalia has a 90% interest in the company.

Ing. Velani explains, for the company to compensate for this increased capacity by a corresponding reduction in the frequency of services—for the reason that existing frequencies represent an irreducible minimum in a competitive market. This is a difficulty which particularly concerns companies of the size of Alitalia.

In fact, pre-planning and seasonal trends have enabled Alitalia, in the first two months of 1961, completely to absorb the increase in passenger capacity and almost completely to absorb the increase in overall capacity, inclusive of freight.

By comparison with the 1960 figures, the passenger load factor increased from 43.8% to 45.6%. The total load factor, however, went down from 46.3% to 45%—a decrease influenced particularly by the introduction, on Jan. 16, 1961, of all-freight services which, in spite of the encouraging results achieved to date, have not yet, and will not for some time to come, have their full impact.

Ing. Velani went on to comment on factors in the present situation of the airline industry as a whole—a situation which had a very marked influence on Alitalia because it coincided with the effects of a programme of rapid expansion.

Since the introduction of turbojets, operators had been compelled to seek a means of accelerating traffic increases. After much study and research the air transport industry had found no better means of attracting traffic than by reducing fares and by promotional activities. It had been assumed that the lower cost of operation of the new turbine transports, together with the increase in the volume of traffic, would more than compensate for the reduction in fares and thus ensure a higher absolute revenue. This reduction in fares had not, however, been balanced by an equally rapid decrease in costs. The increased financial burdens—in the form of the greater initial cost of aircraft, of publicity and commercial expenses necessary in a competitive market, of training and of new equipment and increases in wages of personnel in all categories—were such that the total operating costs did not diminish as forecast.

By way of a postscript to Ing. Velani's remarks, it may be added that Alitalia's move from Ciampino to Fiumicino has also involved very considerable capital expenditure, in that a completely new base had to be built there. This comprises a separate air terminal for all Alitalia's domestic flights, a maintenance area, a training centre and a catering factory. The air terminal is a completely self-contained unit, located close to the main international terminal.

A problem inseparable from any re-equipment programme is that of redundant aircraft, for which there is not always a ready market. Alitalia has taken two very practical steps to solve this problem. A new subsidiary company, Societa Aerea Mediterranea, has been formed with 90% of its capital owned by Alitalia. To this subsidiary company have been transferred three unwanted DC-6Bs with which S.A.M. operates passenger charter flights. This venture could well be a financial success for the reason that many European countries, as well as some American, operate frequent charter flights into Italy while, until now, there has not existed any national charter company. Thus, Italy has charter "credits" all round Europe and in America from which S.A.M. will undoubtedly benefit.

Two of Alitalia's DC-7Cs have been converted into freighters by Douglas, at the cost of some $350,000 each, and with these two aircraft a number of all-freight services were initiated at the beginning of the year. Four regular runs have so far been established—to Tripoli, Beirut and Teheran (each once weekly), and a twice-weekly service to New York. Two more conversions to DC-7Fs are planned for the near future, when a considerable extension of freight routes will take place.

Alitalia, today, is undoubtedly suffering from acute growing pains. Both its international and domestic services lose money. The latter are expected to because fares are uneconomic, but the former are expected to make a profit. The company is fortunate in being backed by I.R.I., a para-statal organization which finances most of Italy's major industries, and which appears to have a bottomless pocket.

But whether or not the company will be able to attain the happy state of economic equilibrium depends on how successfully it is able, in the immediate future, to exploit all the beneficial effects of its expansion programme while avoiding the many inherent dangers.—T. D. CALNAN.

One of Alitalia's two DC-7Fs receives its freight load in preparation for a transatlantic service—two round trips are flown between Rome and New York each week.

Blue Streak's Propulsion System

IN view of the rising tide of optimism in Europe regarding plans for a co-operative programme of aerospace development, new information released on the propulsion system of the de Havilland Blue Streak, which has been offered as the first stage of a European heavy satellite launcher, is of particular interest. The details were given for the first time in a paper by Mr. A. V. Cleaver, chief engineer (rocket propulsion) of Rolls-Royce, Ltd., at last week's European Symposium on Space Technology. A condensed version of his paper follows.

The propulsion system for Blue Streak comprises two Rolls-Royce RZ.2 rocket engines. The engines in this installation are quite separate units, each with its own propellent feed, combustion and control system. The double-engine installation in Blue Streak is designated RZ.12.

The original application of the RZ.2 was for the early development rounds of the Blue Streak ballistic missile. It was intended that the operational missile would be powered by a development of the RZ.2. Following the cancellation of Blue Streak as a weapon, in April, 1960, work on these more advanced engines was terminated, as studies of the Blue Streak as a satellite launcher showed that the existing RZ.2 engine would be entirely adequate for this application.

It is relevant to mention at this point that the RZ.2 engine has been developed and adapted from the very successful S.3 family of engines developed by the Rocketdyne Division of North American Aviation, Inc. A technical assistance agreement between Rolls-Royce and this American company was signed in August, 1955, which has resulted in a very happy relationship between the two firms. The S.3-type engines are used with minor variations in the Thor and Jupiter I.R.B.M.s; the two booster engines of the Atlas I.C.B.M. are also generally similar.

The propellents used are liquid oxygen and kerosene and the sea-level performance, with comparable values at cut-off after approximately 160 sec. of powered flight in the Blue Streak satellite launcher, are shown in Table 1.

The variation in mixture ratio, as between the sea-level and altitude (cut-off, or "all-burnt") cases, reflects the cumulative effect of a change in liquid level and hence relative head in the two propellent tanks, and an increase in vehicle acceleration from 1 *g* (static) to about 10 *g* (at cut-off), which also greatly influences the pump inlet pressure.

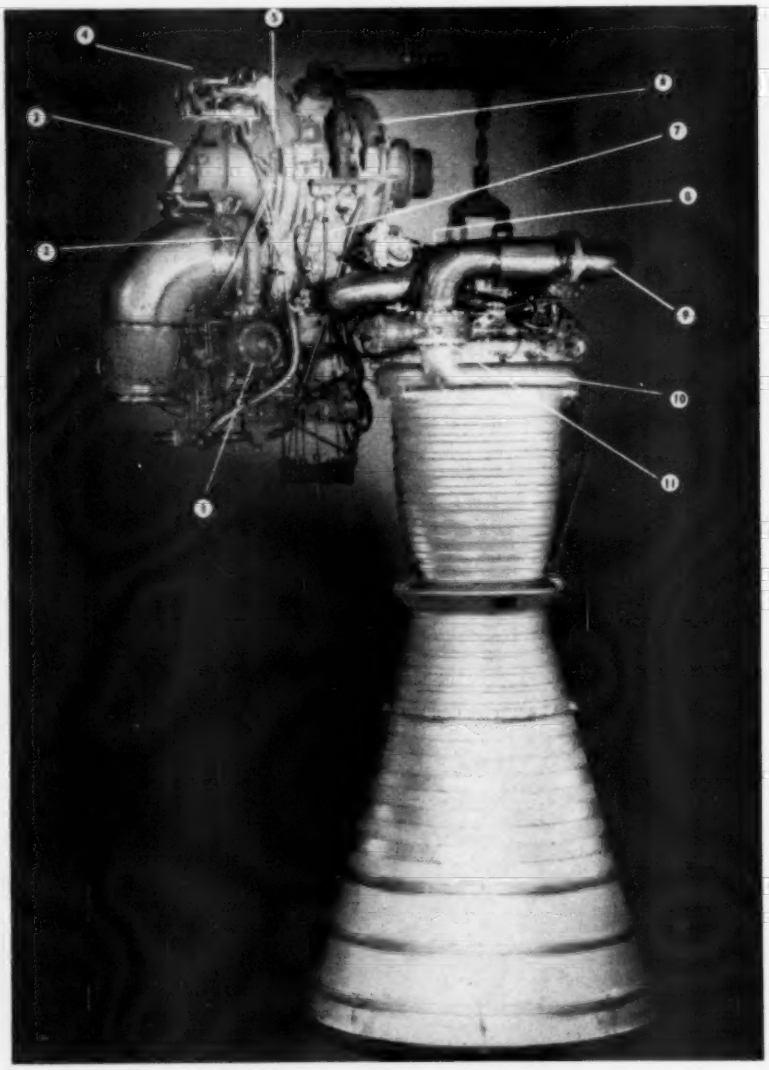


Fig. 1. RZ.2 Rocket engine. 1, Gas generator; 2, Turbine assembly; 3, Engine relay box; 4, Pneumatic manifold; 5, Fuel pump; 6, Lox pump; 7, Gearbox; 8, Main lox line; 9, Main fuel line; 10, Fuel inlet manifold; 11, Main fuel valve.

As will be seen from Fig. 1, each engine has a turbopump set which feeds the propellents to the thrust chamber. The latter is regeneratively cooled, being of tubular-walled construction, and the total flow of kerosene traverses the chamber walls before entering the combustion zone of the chamber. A complete engine weighs 1,500 lb.

The propellent pumps are driven by a turbine via a simple spur reduction gear; the turbine is supplied from the separate gas generator which burns a fuel-rich mixture of the propellents. Such a fuel-rich mixture is required to keep the temperature of the combustion gases down to a value acceptable in the turbine of about 650° C. The mixture ratio to achieve this is about 0.35 (oxygen fuel by weight).

An electro-pneumatic sequential control system is used for operating the various valves during start and shutdown. This is a ladder-type system, in which any given operation cannot take place until a signal has been received signifying that the preceding operation has been satisfactorily completed.

Propellents for starting the engine are supplied from pressurized ground-mounted tanks, and ignition in the gas generator and thrust chamber is by pyrotechnic igniters.

Turning now to installation of the engines, it will be seen from Fig. 2 that the two thrust chambers are mounted directly under the main structural member of the propulsion bay, the turbopumps being mounted to one side of this member. The thrust chambers incorporate gimbal bearing blocks at their attachment points which permit the chambers to be selectively gimballed

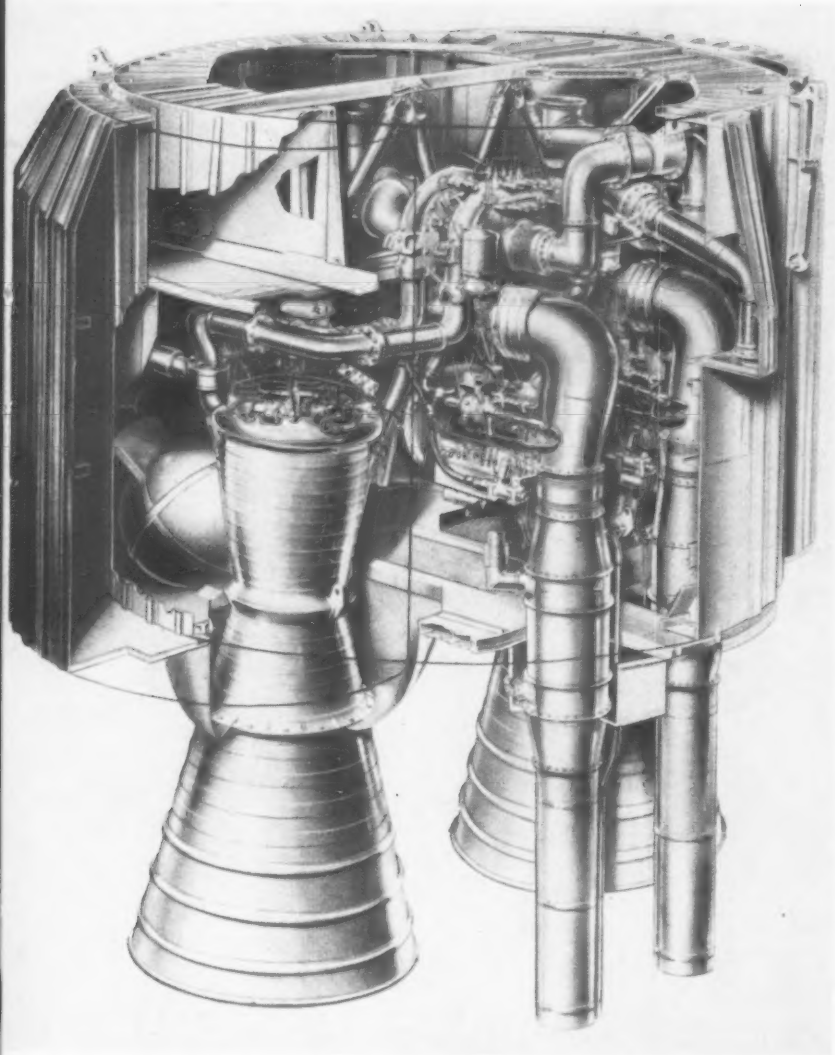


Fig. 2. RZ.12 Propulsion bay.

through ±7° in two planes at right-angles. This provides the means of vehicle yaw, pitch and roll control without any need for separate vernier motors. To accommodate this thrust chamber movement, the high-pressure feed lines from the turbopumps to the chambers incorporate flexible sections.

The bottom of the bay is provided with a heat shield to prevent excessive bay heating which might otherwise arise from recirculation of chamber or turbine exhaust gases. It should also be noted that extensions of the two turbine exhausts contain liquid nitrogen and liquid oxygen heat exchangers which provide gases for pressurizing the vehicle propellent tanks. These heat exchangers together with the whole tank pressurization system, are a de Havilland responsibility, which concern also provides the hydraulic jacks for gimballing the thrust chambers.

Engine System and Operation

The diagrammatic drawing (Fig. 3) of the engine can perhaps be best understood by going through the normal starting and stopping procedures.

It has already been mentioned that the engine operation is sequenced by an electro-pneumatic control system—only the pneumatic portion is shown on this diagram. The electrical sequencing during starting is automatically controlled from a ground-mounted relay box, which feeds into the engine electrical relay box, and the initiation of the sequence requires only the pressing of the "start" button on the control panel in the control room.

All valves are opened and closed by pneumatic (nitrogen) servo-pressures, sequenced by the bank of solenoid valves mounted on the pneumatic manifold. The pneumatic supply is regulated to 750 p.s.i. and taken from high-pressure bottle banks mounted in the vehicle.

The starting sequence is broadly as follows, it again being emphasized that the whole sequence is automatic once the button is pressed. Should any event not take place as programmed, the whole operation is automatically shut down. A further requirement for the sequence to go through to completion is that certain events must not only have taken place, but also have taken place within a certain time interval (e.g., achievement of steady state engine running).

1. The engine start signal causes the ground start tanks and lubricating oil tank to be pressurized.
2. Firing of the thrust chamber igniter is initiated.
3. When an electrical link in the thrust chamber igniter burns through, opening of the main liquid oxygen valve and (by pneumatic interconnection) the fuel igniter valve is initiated. Thus liquid oxygen under tank head, and a pilot flow of fuel under start tank pressure, enter the thrust chamber, and are ignited.
4. A lox-rich flame is established which breaks an ignition detector wire stretched across the thrust chamber exit.
5. Breaking of this wire initiates "main stage" by firing the gas generator igniters. Links in these igniters burn through and signal the main fuel valves to open.
6. Fuel valve opening initiates opening of the gas generator blade valve—thus supplying hot gas to the turbine which accelerates the pumps and begins to feed propellents at high pressure to the thrust chamber and gas generator.
7. When pump outlet pressures exceed start tank pressures the fill-and-check valves at the exit from the start tanks close and the start tanks are vented. The engine is now fully self-sustaining and the start sequence is complete.

Once the engine is started, automatic cut-off occurs (during ground running) if certain "red-line" parameters go outside specified limits. Examples of these are turbine speed, liquid oxygen pump bearing temperature, etc. There is also a rough combustion cut-off device, which shuts the engine down if more than a pre-set number of vibrations, giving more than a certain acceleration level at the chamber head, occur within a specified period.

The sequence from engine start to full thrust takes about 4 sec. The average thrust build-up rate from 10% to 90% rated thrust is about 0.7×10^6 lb./sec., the maximum rate being about 2.25×10^6 lb./sec. This is with what is called a "wet" or "water-lead" start, i.e., the thrust chamber jacket is filled with water, which precedes the kerosene into the chamber.

Shut-down in flight is effected by a signal from the vehicle control system. The sequence is such that the gas generator valve and the liquid oxygen valve close some 200 milliseconds before the main fuel valve. A fuel-rich cut-off gives more repeatable thrust decay and reduces the residual impulse.

Average rate of thrust decay from 90% to 10% thrust is about 0.4×10^6 lb./sec., maximum rate being 1.4×10^6 lb./sec.

Development Experience

Before proceeding to discussion of RZ.2 experience, mention should be made of experience with an earlier engine, the RZ.1.

In order to gain experience, as quickly as possible, on the problems involved in manufacturing and testing large rocket engines, it was decided to build six RZ.1 engines, which were virtually "Chinese copies" of the S.3 engine, and which could be available for testing while design and manufacture of the RZ.2 was still proceeding.

The major differences between the RZ.1 and S.3 were generally concerned with convenience in British material supply and manufacturing techniques. Particularly in respect of proprietary items such as non-return valves, solenoid valves,

TABLE I

	Sea Level	Cut-off (about 250,000 ft.)
Thrust—lb.	137,000	168,000
Specific Impulse—sec.	245	289
Mixture Ratio: $\frac{\text{Liquid Oxygen}}{\text{Kerosene}}$	2.16	2.45

etc., a number of parts of American manufacture were used. The turbine assembly to the Rocketdyne design was retained, except that the blade root fixing was of the fir tree type, instead of welded construction.

Testing of this engine took place at the Rocket Propulsion Establishment at Westcott, pending availability of Spadeadam, and the first engine run was in May, 1958. The programme lasted for 10 months, 53 minutes total duration being accumulated in 160 tests. The longest single run was 55 sec. (limited by the test stand propellent tank capacity) but many runs exceeded 30 sec. Maximum thrust attained was 140,000 lb. This testing was extremely useful as, besides providing the large rocket engine experience needed, it threw up problems related, for example, to thrust chamber and injector life which enabled action to be taken in anticipation of the RZ.2 programme.

Increasing Reliability

Turning now to the RZ.2 testing, the first firing took place at Westcott in March, 1959, and testing commenced at Spadeadam in August of the same year. The first double-engine (RZ.12) firing took place at Spadeadam in March, 1960. Since the weapon cancellation, testing has continued, though at a reduced level, pending the decision on a European space programme, but the first engine runs under a Blue Streak missile have now taken place.

Total experience to May, 1961, is summarized in Table II.

TABLE II

	RZ.2	RZ.12
Tests of scheduled duration ..	317	48
Successful starts (at least ½ sec. main stage)	365	51
Starting attempts	474	55
Runs of 150 sec. or greater ..	8	8
Total duration—sec.	7,733	2,532

Although on the RZ.2 the incidence of failures to start or reach scheduled duration may appear high, a great number of these failures were due to faults in the complex test facilities (particularly in the early days of their operation) and were not due to the engine system.

In a satellite launching vehicle, what we are really interested in is the ability of the engines to run successfully for scheduled duration; this we call the running reliability. Starting reliability is, of course, also important but a fault on starting does in general only result in a delayed launch. A fault once the vehicle is launched results in an aborted mission.

The RZ.2 running reliability is currently 96%, the starting reliability being 92%. The overall reliability, obtaining from the product of these two figures, is 88.4%. These figures would imply double engine reliabilities of 92.1% (running), 84.6% (starting) and 78.1% (overall). In fact, the double engine tests so far carried out give reliability values of 100%, 95% and 95%! This apparent discrepancy is partly due to the small sample so far available, and partly because the double engine tests have been done later in the programme with improved engines of more recent modification standards. The single engine reliability includes results right back to the first engine run. Continual improvement of reliability standards is one of our main development aims.

In parallel with this engine testing, a great deal of component

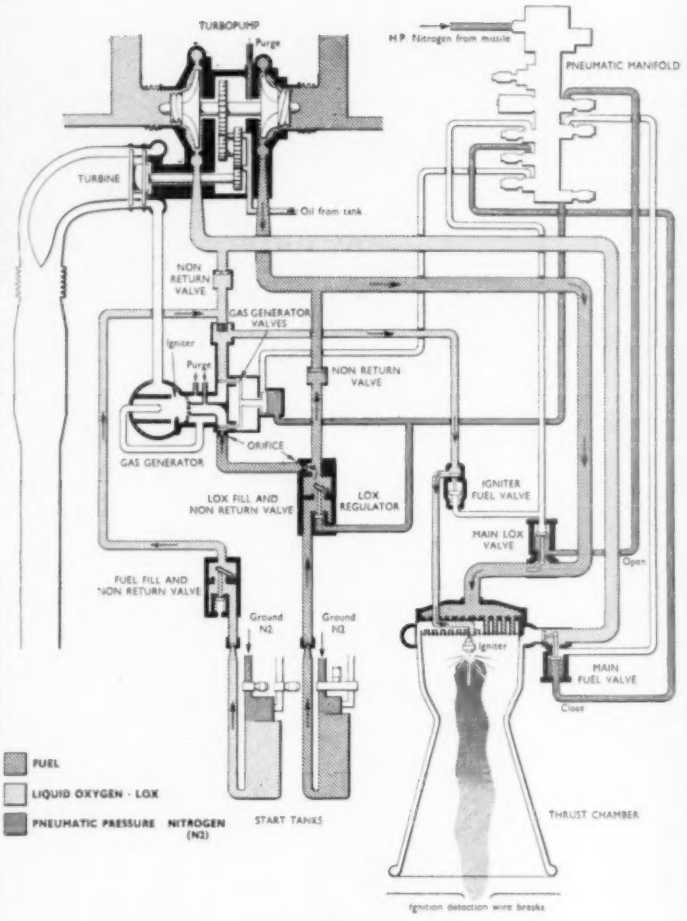


Fig. 3. RZ.2 ignition stage.

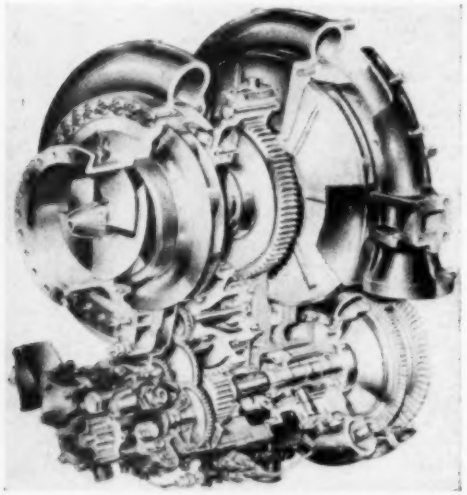


Fig. 4. RZ.2 turbopump.

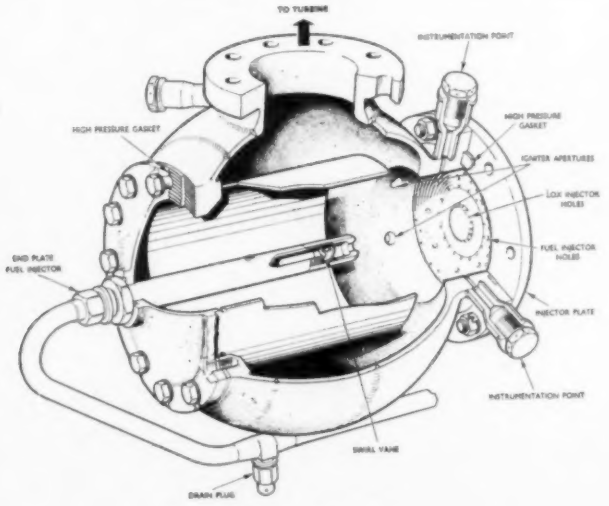


Fig. 5. RZ.2 gas generator.

testing has also proceeded. Some 530 tests totalling 35,000 sec. have been completed on RZ.2 turbopumps, and some 1,600 tests totalling 83,000 sec. on gas generators. This testing has been very valuable in providing performance data and, also, for proving design changes prior to engine testing.

A great deal of turbopump testing under a missile has also been carried out by de Havillands at their Hatfield test site, to prove the missile tank pressurization systems, etc.

We have had our problems and failures.

A liquid oxygen pump explosion was traced to diffuser vane fretting and the design has been altered and tested successfully on a turbopump.

A slow non-standard start on one test blew the thrust chamber off—a contributory cause was found to be a bad weld and necessary action was taken. Thrust chamber and injector manufacturing techniques were found to be critical in obtaining good running life but we feel this problem has been overcome.

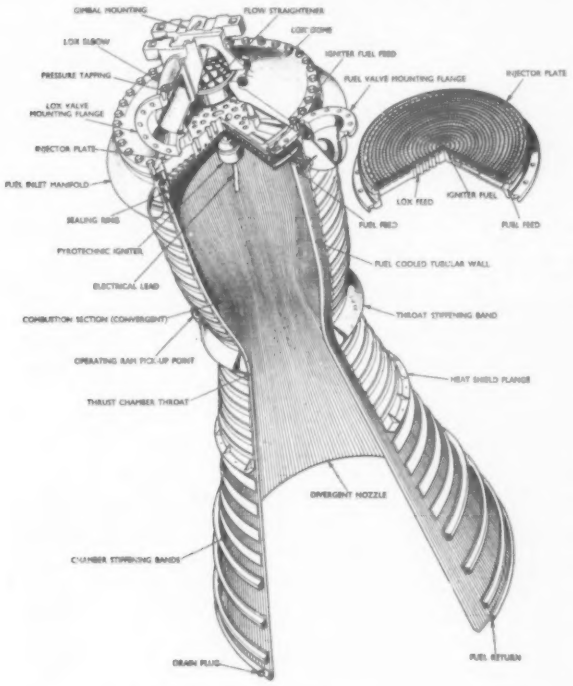


Fig. 7. RZ.2 thrust chamber.

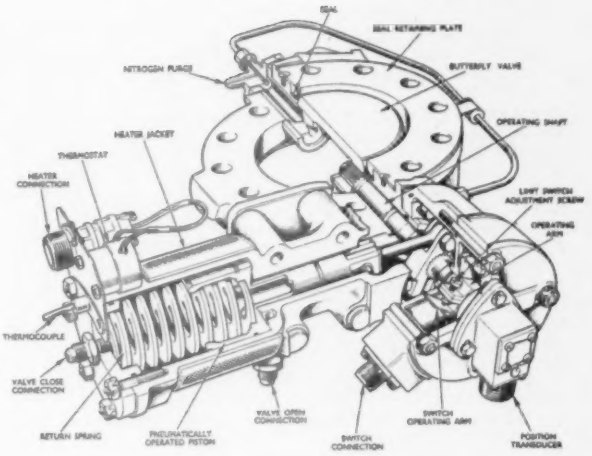


Fig. 8. RZ.2 main Lox valve.

To summarize, the mechanical development is going well and consistent performance has been established. Flight engines are being delivered to within 1½% of the specification thrust (with a further allowable 1½% run-to-run variation). Similar tolerances are being held on engine mixture ratio.

What of the future potential of this engine? It is already being run at 150,000 lb. thrust ratings which would be demanded for certain satellite launchings and, with relatively minor modification, could probably give thrusts at least 10% higher. Tests carried out show that the engine can run stably down to about 50% thrust and, no doubt, could achieve lower levels by further modifications to the thrust chamber injection system. A throttling version of the engine, with controlled thrust, could therefore be provided if required.

This basic engine which could provide the boost power for the first European satellite launching vehicles is in itself capable of further development to meet more sophisticated demands that may be made of it. The experience and knowledge gained in its development would be invaluable in the design of larger improved engines which would, no doubt, be required as the programme expanded.

Anti-missiles from Orbit?

A RESEARCH programme "which may lead to the development of satellite interceptors capable of destroying enemy ballistic missiles within minutes of launching" has been disclosed by the U.S. Department of Defense. The programme is called Bambi, short for Ballistic Missile Boost Intercept.

The scheme envisages the use of a large number of satellites capable of detecting enemy missiles as soon as they are launched and of releasing anti-missiles against them. Following the studies they have made with surface-launched intercepting missiles, the U.S.A.F. has been drawn to the conclusion that the best time to intercept enemy missiles—if it proves technically possible—is during the launching phase when they are still travelling at relatively low speed. At this stage, too, the warhead is still attached to the missile and the interception problem is uncomplicated by the presence of the separated, and possibly fragmented, missile afterbody.

At present, the Bambi system envisages the use of satellites equipped with infra-red scanning equipment capable of detecting the heat emanations of launched missiles (as in the case of Midas). The same satellites or companion orbital vehicles would then launch heat-seeking missiles to destroy them.

Feasibility studies are being conducted by Space Technology Laboratories and Convair, with Hughes Aircraft devoting their attention to such problems as IR-search, tracking and closing engagement. Individual contracts amount to about $1.25m.

Clearly, there are many formidable problems to be overcome before any realistic development of the system can be accomplished. First, of course, is the difficulty of establishing a suitable "jump-down" system which is reliable, fast-acting, safe and foolproof—one, for example, which will remain impassive in the face of routine missile testing and space-vehicle launching.

Apart from investigating the feasibility of such a defence system, one of the main aims of the studies is to determine how expensive it is likely to be.

Capturing a Meteorite

A NEW series of firings has begun at White Sands, New Mexico, in which Aerobee-Hi sounding rockets are being sent into near-space in an endeavour to recover dust particles and micro-meteorites for physical examination before they are contaminated by the Earth's atmosphere. In this way it is hoped to learn more about the composition of extra-terrestrial matter.

In the current experiments the nosecap of the rocket is designed to move forward—when at a height of about 40 miles—to reveal eight extensible leaves which fold outwards from the base of the payload section. The leaves, which embody electron microscope screens and plastic material for snaring the dust particles, remain open as the rocket ascends under momentum to about 100 miles, being finally retracted when the container has fallen to within 55 miles of the Earth. The nosecap is then drawn back over the leaves, sealing the payload section. The nose compartment separates at about 50 miles and falls in a tumbling mode to 20,000 ft., when a pilot parachute opens. At 10,000 ft., the main canopy deploys for final recovery.

Europe and Space Technology

OPENING the European Symposium on Space Technology in London on Jne. 26, Dr. W. R. Maxwell, president of the British Interplanetary Society, said it was hoped that the present meeting would be the first of a long series. In addition to European delegates, there were several visitors from the United States. He particularly welcomed Dr. Theodore von Kàrmàn, "that great international figure who has just experienced his 80th birthday and is still going strong."

Dr. Maxwell said that at the present time there was a good deal of discussion concerning the Common Market and European trade agreements generally and it seemed obvious that this trend of co-operation should be extended to include space technology. Europe had contributed to the fundamental concepts of astronautics, from the Laws of Motion established by Newton and Kepler, to the invention of wireless and the liquefaction of oxygen and hydrogen. It was impossible to imagine that Europe could stand aside from the important developments that were now taking place. Her resources in materials and manpower, he said, were at least as great as those of the two great Space Powers and suitably organized they would constitute a third great Power in space. Air transportation had brought peoples closer together and language difficulties had become less and less, introducing new opportunities for collaborative effort which had so far been largely dormant.

Taking the chair at the first of four technical sessions, Prof. von Kàrmàn said that his personal feeling was that even if space research had no immediate practical application—in such fields as meteorology and communications—scientific and intellectual curiosity would be sufficient to ensure that the necessary money and resources were forthcoming, "so strong is the urge to know what is in the space around us."

Meteorological Rocket Networks

The lectures themselves covered a wide field and in the main concentrated on immediate problems. One of the first was a paper by Herr Heinrich Faust (Deutscher Wetterdienst Zentralamt) which stressed the importance of extending meteorological sounding rocket observations under the title, "The Scientific Necessity for a Rocket Network in Europe."

All firings of research rockets, Herr Faust said, even during the International Geophysical Year, have so far been more or less sporadic. Although each firing has brought new information, large-scale situations, especially in the flow fields of the stratosphere, could only be investigated through questionable statistical averages obtained from inter- and extra-polation. Scientific analysis of specific conditions, such as stratospheric wind and temperature distribution, was impossible.

As the result of a suggestion by Dr. Hans Aufm Kampe, a meteorologist of the U.S. Signal Corps, in 1958 a rocket network of the kind envisaged was already operating in the United States, and there was hope that this could be extended to include a European network. It was apparent, Herr Faust said, that in the stratosphere and in still higher atmospheric layers, conditions exist which can only be resolved by measurements taken on a global scale. To achieve this, it was necessary to conduct rocket launchings at all stations through several sequential days every season.

To extend the area of investigation, it was desirable to set up rocket stations in Europe as far as possible in a north-south direction. It was proposed to establish stations in North Scandinavia, in South Scandinavia, in Germany, in Sardinia, and in North Africa. Similar stations over the western part of Great Britain and France, and later on in weather ships in the Atlantic, would be of importance as links to the American network, Herr Faust concluded.

There are obvious opportunities here not only for cheaply produced solid-propellent sounding rockets (such as those being produced by Bristol-Aerojet and various American companies) but also, as one American speaker pointed out, for the development of suitable low-cost ground tracking equipment.

Another paper introducing opportunities for European industrial development was given by Mons. G. J. Broussaud *(Compagnie Générale de Telegraphie sans Fil)* under the title, "A New Type of Navigational Satellite." This envisaged the development of a light-weight satellite which could be used for obtaining a precise navigational "fix" for ships and aircraft. It would be simpler than the American Transit satellite, eliminating the need for the tape-storage of orbital data, and hence would be immune to anyone flooding the satellite with spurious signals.

The essence of the French design is that both the satellite and observer possess a (quartz) clock which controls the triggering of pulse trains, thereby producing a common time standard. The satellite carries a transmitter modulated by the pulse train and radiating substantially omnidirectionally in space. The observer receives this signal and, after amplification and detection, compares it with that supplied by his own clock. From the difference in time between two homologous pulses, he can deduce the distance from the satellite at the time of these pulses. The relative positions of the satellite and the observer can then be deduced precisely.

Other speakers dealt with the problems of satellite stabilization, which are now engaging the attention of at least two British industrial concerns. B. Stewart and P. A. E. Stewart (Hawker Siddeley Aviation) in their paper "Dynamics and Engineering of Satellite Attitude Control Systems," examined in detail the merits of both rotating flywheels and jet reaction systems. They disclosed that a "private venture test rig" had been built by the de Havilland Engine Co. at Hatfield for the purpose of testing the characteristics of hydrogen peroxide at low thrust values for achieving attitude control. The test device produces a thrust of three to eight ounces at a flow rate of about .007 lb./sec.

It is proposed to test this unit on a suitable rig for general characteristics of operation and response, and then to build it in the form of a free rig. A two-axis system will be built later to test cross-coupling effects and, eventually, three-axis systems.

While Hawker Siddeley's present investigations are largely related to communication satellites, Elliott Brothers (London), Ltd., have been devoting similar attention to the problems of stabilizing an astronomical satellite. That this company was engaged in this work was first disclosed during the S.B.A.C. Show last year, when it became known that the Ministry of Aviation had placed contracts for studies by industry of various aspects of satellite problems. The research programme is being co-ordinated by the R.A.E.

Attitude Control

Elliott Brothers' contribution was described at the European Symposium by Messrs. J. A. Taylor and J. R. Fell in their paper, "Attitude Control of an Astronomical Satellite." R.A.E. studies, acting on the requirements of the Royal Society, had led to the concept of a satellite consisting essentially of a reference platform containing six or more telescopes directed at certain fixed stars, and an astronomical telescope which is attached to a stable platform by a two-axis mount. Elliott's were asked to investigate the problems of attitude control and possible methods of controlling the astronomical telescope.

The satellite is required to be placed in an almost circular orbit at an altitude of about 300 miles. The orbital period would be about 90 minutes, and during the expected lifetime of one year, some 5,000 orbits would be completed. The orbital plane would be inclined to the equator so that the oblateness of the Earth would produce a precession period of one year. By this means, some 40 minutes of observing time would be possible during each orbit while the satellite was in the Earth's shadow. The remainder of each orbit would be used to recharge the batteries by solar cells and re-direct the telescope as required.

With a total mass of 1,400 lb., the satellite envisaged is to be space-stabilized to an accuracy of ± 1 minute of arc. Final acquisition of the observed star is by fine adjustment of a mirror which aligns the image of the star onto the slit of a spectroscope. A position accuracy of ± 2 seconds of arc of the star image with respect to the slit is required.

Although a number of methods of attitude control have been investigated, it was decided to concentrate on reaction jets. With the satellite system at present envisaged, where the difference in moments of inertia is large, it was considered that the flywheel system would be excessively heavy. And while a system of flywheels and jets would offer system advantages, this would be at the expense of engineering complications.

For stabilization six or more small telescopes are arranged in a rigid frame of reference so that they all point towards fixed stars when the frame is correctly aligned. However, since some of these stars will be occulted by the Earth or blurred by the atmosphere, not more than three telescopes will be used at any one time. These telescopes provide single-phase error signals which are used to actuate reaction jets, maintaining the stabilization of the reference platform in space.

The astronomical telescope, carrying two pick-offs, is slewed by servomotors to the desired co-ordinates. Since it is free to rotate about two axes with respect to the reference platform, complete coverage is available. In order to prevent motion during the observation period, mechanical brakes are used to lock the astronomical telescope, in both planes, to the reference platform, which is stabilized by means of the gas-jet system.

Electric Propulsion

Another interesting paper from Elliott Brothers was given by Mr. P. C. McNeill, which dealt with "The Application of Electric Propulsion to Satellite Control." This discussed in some detail the relative merits of various small ion and plasma accelerators, showing that for long missions they can represent a distinct advantage over other methods of attitude control. The author concludes, however, that several serious development problems remain to be solved before such devices can be considered reliable.

Two papers from E.M.I. Electronics dealt with detail considerations of satellite communications. The first, by Dr. S. C. Ghose, dealt with "Digital Techniques in Space Communications," in which many channels of telephone speech and also television can be simultaneously transmitted over the same carrier, via a satellite, without accumulated signal noise. In the second paper, Mr. F. Charman outlined some of the difficulties which face the communication engineer in space aerial design.

Although space does not allow mention of all the other papers presented at this extremely successful, and technically rewarding Symposium, one cannot close without mention of a novel contribution by Messrs. P. A. E. Stewart and J. F. Swale (Hawker Siddeley Aviation). Entitled "A Lightweight Solar Propulsion Unit for Transfer to a 24 hr. Orbit," it describes a design (Patent Application No. 15479/61) for a light-weight solar propulsion unit, using hydrogen as propellent, for raising a communication satellite from a low-circular orbit into a geostationary orbit at 22,300 miles.—K.W.G.

The Fighting Services

First Operational Wessex Squadron

LAST Tuesday No. 815 Squadron was due to be commissioned under the command of Lieut. Cdr. A. L. L. Skinner, R.N., at R.N.A.S. Culdrose as the first front-line Fleet Air Arm squadron to be equipped with Westland Wessex helicopters. This introduction of the Wessex HAS. 1 into operational service will enable the Navy to return to the "single package" concept of anti-submarine aircraft, as opposed to the present helicopter technique where one Whirlwind carries the detection gear and another the means of killing the submarine.

No. 815 Squadron has had a distinguished history which includes participation in the attack on the Italian Fleet at Taranto, and the battle of Cape Matapan, in both of which actions, its Swordfish achieved considerable success. In October, 1943, the Squadron was rearmed with Barracudas, and used this type until 1953. By then its aircraft had become a familiar sight in the skies of Northern Ireland for the Squadron spent many years at R.N.A.S. Eglinton—hence the harp insignia still borne by its aircraft.

Fighter Evaluations

OFFICERS from the Central Fighter Establishment and from the Centre d'Experience Aériennes Militaire (the French Fighter Development Unit) at Mont-de-Marsan, are to make reciprocal visits to the two units this month for exchanges of views and information concerning their latest aircraft. Gp. Capt. D. Crowley-Milling will lead the C.F.E. team in France from Jly.17-22, while the Commandant of the C.E.A.M., Col. F. Maurin, will head the French team visiting the C.F.E. from Jly. 24-28. Air Cdre. E. G. L. Millington, the C.F.E. Commandant, will welcome the French party.

In France the R.A.F. officers will fly the Mirage, Mystére and Vautour, and in this country the French team will fly Hunters, Javelins and Lightnings.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Gp. Capt. L. D. Mavor, A.F.C., and Wg. Cdr. J. McD. Craig, D.F.C., to the Department of the Chief of the Air Staff; Wg. Cdr. P. L. Crowell, Wg. Cdr. J. Brain, A.F.C., and Wg. Cdr. A. A Storar, M.B.E., to the Department of the Air Member for Supply and Organization, the first with acting rank of Gp. Capt.

Bomber Command: Wg. Cdr. D. B. Ainsworth to R.A.F. Feltwell to command the Administrative Wing.

Fighter Command: Wg. Cdr. C. M. Gibbs, O.B.E., D.F.C., to R.A.F. Chivenor as Chief Instructor and to command the Flying Wing; Wg. Cdr. L. S. Laughton to R.A.F. Middleton St. George to command the Flying Wing; Wg. Cdr. D. B. Wills, D.F.C., to No. 23 Squadron, R.A.F. Coltishall, to command; Wg. Cdr. M. Scannell, D.F.C., A.F.C., to Headquarters, No. 12 Group, for operations duties.

Coastal Command: Wg. Cdr. V. O. Joseph to Headquarters for staff duties.

Transport Command: Sqn. Ldr. J. A. Heatherill to Headquarters for operations duties, with acting rank of Wg. Cdr.

Flying Training Command: Sqn. Ldr. J. Corbishley, A.F.C., to the Central Flying School, Little Rissington, to command the Helicopter Wing, with acting rank of Wg. Cdr.

Technical Training Command: Wg. Cdr. R. O. Bater to No. 12 School of Technical Training, Melksham, as training officer; Wg. Cdr. E. Essame, B.A., to the School of Education, Uxbridge, as Youth Leadership Instructor; Wg. Cdr. E. W. Hassall, M.B.E., to Headquarters as Wg. Cdr. Plans; Wg. Cdr. E. W. D. Roy, D.F.C., to R.A.F. St. Athan to command the Administrative Wing.

R.A.F. Germany: Wg. Cdr. J. C. Bevan to Headquarters as Command Signals Officer, with acting rank of Gp. Capt.

R.C.A.F. Vertol 107s

TWO Boeing Vertol 107s ordered recently by the Canadian Government for the R.C.A.F. are to be highly specialized search and rescue helicopters. Designated CH-113s, they will be capable of lifting external loads of up to 10,000 lb. with a special air-to-surface cargo hook which can be stowed in the freight compartment when not in use. With the aid of extended, larger capacity fuel tanks they will be able to carry a 2,000-lb. payload over a distance of more than 650 miles without refuelling.

The R.C.A.F. CH-113s are to have an intercom system which can be lowered to establish communication between the helicopter and the personnel to be rescued. They will also be equipped with a radar system for search and rescue work, and will have a 600-lb. capacity cargo and personnel hoist which can be lowered through a rescue hatch in the centre of the cabin floor.

To be flown by a two-pilot crew, the CH-113s are to have an all-up weight of 18,700 lb. and a cruising speed of 150 m.p.h. They are due to be delivered to the Service next year.

More Service News

No. 92 Squadron.—The Air Ministry has now published a booklet on No. 92 Squadron (Sqn. Ldr. B. P. W. Mercer, A.F.C.).—the new Fighter Command aerobatic team. With a foreword by Air Marshal Sir Hector McGregor, the A.O.C.-in-C., the publication covers the techniques and developments of formation aerobatics, a history of the unit and some background details on its present pilots and leading groundcrew personnel.

Sassoon Trophy.—Five squadrons from R.A.F. Germany and one R.Ne.A.F. Squadron are to compete for the annual Sassoon Photographic Challenge Trophy award on Jly. 25. The present holders of the Trophy are No. 80 Squadron, 2nd A.T.A.F.

Beverley Service.—To mark the first five years of squadron service by R.A.F. Beverleys, Blackburn Aircraft have produced a booklet entitled "No Other Aircraft . . . ." It covers the work of these aircraft and the five Transport Command squadrons which operate them in Europe and the Near, Middle and Far East.

R.O.C. Summer Camps.—For the second consecutive year approximately 3,000 members of the Royal Observer Corps will be attending summer camp at R.A.F. Binbrook. Being held between now and Jly. 28, this year's camp is divided into five phases of one week each.

Hong Kong Auxiliaries.—Operating Wideons and Austers, the Hong Kong Air Force at present comprises two R.A.F. officers and seven technicians in addition to a locally recruited establishment of 39 officers and 110 airmen. Its work includes a "flying doctor" service to the remote areas and islands of the Colony and participation in the local R.A.F. search and rescue organization.

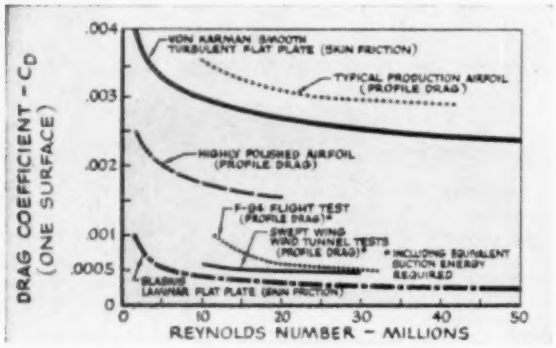
VETERAN WORKHORSES.—There are still approximately 48 Hastings in service with the R.A.F. transport force. Here, two of this type from No. 36 Squadron (Wg. Cdr. L. F. Wolsey) at Colerne are seen over Mt. Kilimanjaro, Kenya.

Laminar Flow for Transport Aircraft

Much research work is being done in this country—notably by the Handley Page team under Dr. G. V. Lachmann—relating to the problems and possibilities of boundary-layer control for transport aircraft with full laminar-flow surfaces. This article reviews some important American work in this field.*

EARLY in 1963 Northrop Corporations' Norair Division will begin flight trials with a large jet aircraft with laminar-flow control over the whole of its wing surface. This test programme, conducted under a U.S.A.F. contract valued at $20 million, is reckoned to be the most ambitious attempt so far to demonstrate the advantages and practicability of boundary-layer control when applied to full-scale aircraft.

The Northrop work in this field dates from 1949, when a joint U.S.A.F./Northrop effort was initiated under Dr. Werner Pfenninger. In the 12 years since the programme started, a low-drag (rather than high lift) system has been developed, making use of suction slots in the surface to be controlled. Research has covered theoretical and experimental work, laboratory testing, wind-tunnel programmes and flight demonstrations with a sleeve on a Lockheed F-94.



Some results of the Northrop research programme into laminar-flow control are shown on this diagram, which plots drag coefficient against Reynolds number for a variety of different aerofoils.

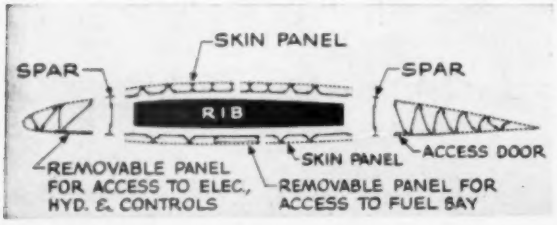
The major points of this programme can be summarized as follows:

1952. Testing in the N.A.C.A. T.D.T. tunnel resulted in 100% laminar flow up to Reynolds numbers of 16 million.

1955. Design and development of a practical suction method which obtained the aerodynamic requirement of laminar flow while maintaining structural rigidity through the aerofoil.

1955 to 1957. Practical application of experimental results carried out on a modified F-94 which completed more than 300 laminar-flow test flights. The F-94 was first flown in the same configuration as tested in the N.A.C.A. tunnel and was modified later in the programme to a suction configuration which was compatible with structural and manufacturing requirements. Tests on this aircraft virtually confirmed the feasibility of laminar flow on large straight wings with 100% laminar flow achieved at Reynolds numbers as high as 36 million. Suction was applied to 69 slots in the upper surface of the glove.

1955 to 1956. Application of electronic data processing to the solution of boundary-layer equations which made possible the analytical design of suction surfaces.



1955 to 1956. Northrop ran tests on a 30° swept wing in the University of Michigan wind-tunnel at Reynolds numbers of 12 million. The model provided confirmation of analytical design methods and demonstrated the feasibility of applying low-drag boundary-layer control to a swept wing.

1958. Demonstration of full-chord laminar flow on a biconvex wing at speeds as high as Mach 2.77. Later tests were conducted in the Ames tunnel on a 30° swept wing with a modified 66-012 aerofoil, achieving full laminar flow at Reynolds numbers of 28 million. This latter test substantiated Northrop beliefs that laminar flow was completely feasible on large swept-wing aircraft.

Some of the results of the test programmes are shown in the diagram (this page), in which drag coefficient is plotted against Reynolds number for several different aerofoils. The swept-wing curve on this diagram shows the feasibility of laminar-flow control (LFC) on a modern jet transport aircraft, and reflects the results of the 1958 tests in the Ames 12-ft. wind-tunnel referred to above.

Demonstration Aircraft Programme

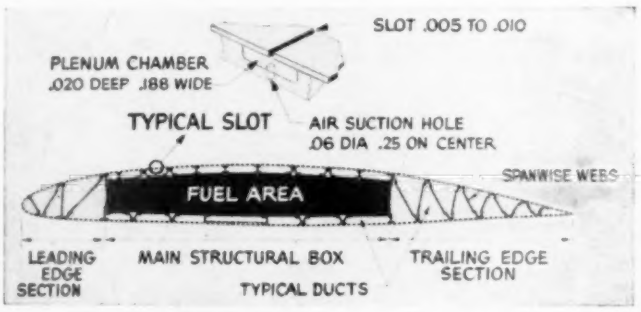
Northrop was awarded a contract in August, 1960, to modify two Douglas B-66s for a full-scale demonstration of LFC. The aircraft concerned are actually WB-66D weather-reconnaissance versions of the B-66 twin-jet light bomber, and the modifications which Northrop will make are extensive. A completely new wing is being built, with a span of 93 ft. 6 in. and an area of 1,250 sq. ft., compared with the 72-ft. 6-in. span and 780-sq.-ft. area of the original aircraft. To permit the widest possible range of tests on this wing, the engines have been removed from their underwing position to pods on each side of the rear fuselage, and General Electric J79-GE-3As are used in place of the Allison J71s in the standard B-66. The gross weight will be 83,000 lb.

"Pumping nacelles" are located under each wing. Each contains a suction compressor, driven by bleed and "bleed-burn" turbines operating on air ducted from the main propulsion engines. In a production application of laminar-flow control to a transport aircraft, the pumping system could be carried in wing-mounted engine pods.

A typical LFC wing structure, of the type to be used on the test aircraft, is shown in an accompanying illustration, and could be applied to a wing with integral fuel tanks. The leading- and trailing-edge sections serve as full-depth LFC ducts; in the area of the torsion box, suction requirements are low and the ducts are part of the skin panel. Extensive use is made of known bonding techniques, to satisfy the LFC contour and smoothness requirements without exceeding production costs of conventional wing structures.

In the demonstration wing the upper and lower skin panels

* Based on a paper by Mr. Welko E. Gasich, presented at the joint I.A.S./A.R.S. meeting in Los Angeles, Jne. 13-16, with additional information given by Northrop at the Paris Aero Show.



A typical LFC wing section is shown above. The test aircraft will have a section similar to this, broken down for manufacture into four main components as shown on the left.

The two Northrop NB-66D research aircraft, to fly in 1963, have a completely new wing, with pumping nacelles each side, and the main propulsion engines rear-mounted on the fuselage.

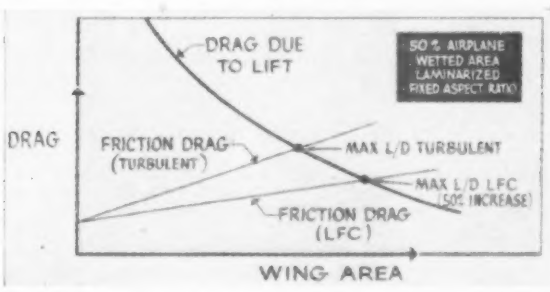
and the leading-edge and trailing-edge sections are made up as bonded assemblies and are attached to each other and to ribs and spars with mechanical fasteners. Northrop is now making wing tooling fixtures—including a number of bonding fixtures with a wave-free contour accurate to 0.002 in.—which are used as pressure bases.

Complete wing panels, some 4 ft. by 20 ft., are assembled before the slots are cut in the skin. A radial-type saw attachment is used to cut the slots. Northrop experience indicates that this type of construction is no more expensive than a conventional "turbulent" wing structure when 25 or more units are produced.

The cost of maintaining an LFC wing in service works out about 9% above that for a non-laminar aircraft, because of the need for a wipedown of the wing before each flight and periodic inspection and checks for waviness and gap clearance.

Transport Possibilities

A study of the skin friction drag coefficient of transport aircraft in the past 30 years shows that the rate of reduction has slowed virtually to a standstill, at a level a little above the lowest possible limit for a turbulent flat plat at approximately 40 million Reynolds number. The application of LFC, potentially available in 1965, offers a further reduction in friction drag to about 60% of this figure. One basic result of



Application of LFC to transport aircraft increases the optimum wing area for a given take-off weight.

this is that the optimum wing area for the same take-off weight is increased (see diagram).

Northrop has made a parametric study of a family of aeroplanes, both non-laminar and with laminar-flow control, to determine the variation of direct operating cost with design range. A 50,000-lb. payload at the design range was assumed, with a maximum payload of 70,000 lb. obtainable by off-loading fuel. A 10,000-ft. runway length limit was accepted, and all aircraft had the same size fuselage; LFC was assumed to be applied to wings and tail surfaces. The studies showed that for a take-off weight of 250,000 lb., the LFC aeroplane had a 60% range advantage, and that at 4,000 naut. miles design range LFC allowed a 14% lower take-off weight.

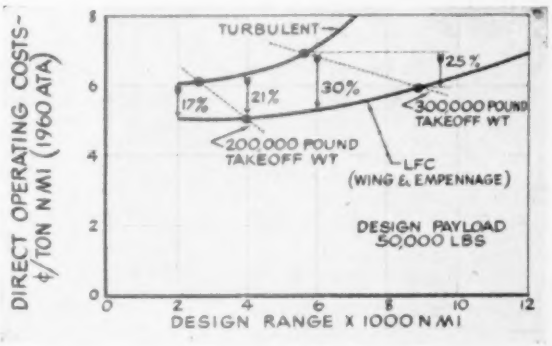
Direct operating costs were calculated by the ATA 1960 method and showed a reduction, with LFC, of from 17% to 30% for ranges from 2,000 to 6,000 naut. miles. The D.O.C. curves for these optimized aircraft are shown in an accompanying diagram.

A separate study has been made to assess the effect of applying LFC to a known aircraft type—the MATS freighter design to SOR-182 [presumably the Lockheed C-141, although the paper does not identify the aircraft positively.—ED.]. This is a turbofan-powered aircraft with a 6,000-ft. runway requirement, able to carry 50,000 lb. for 4,000 naut. miles and 20,000 lb. for 5,500 naut. miles; cruising speed is Mach 0.80.

The use of LFC in this case makes it possible to enlarge the wing area from 2,800 sq. ft. to 4,000 sq. ft. for a take-off weight of 267,000 lb., and to reduce the engine thrust by 30%. The payload/range characteristics are shown in an accompanying diagram, in which it will be seen that the LFC aeroplane flies 30% farther with a 50,000-lb. payload and 33% farther with 20,000-lb. payload. At 4,000 naut. miles range, the LFC version is 23% cheaper on D.O.C.; at 5,500 naut. miles (e.g., Los Angeles-Paris) the reduction is 43%.

The Future

Adoption of the LFC in transport aircraft will, it is suggested, cause evolutionary changes in aeroplane design, in the same way that the introduction of cantilever monoplanes made it worth while to cowl engines and retract undercarriages. In the case of subsonic aeroplanes, these changes can be

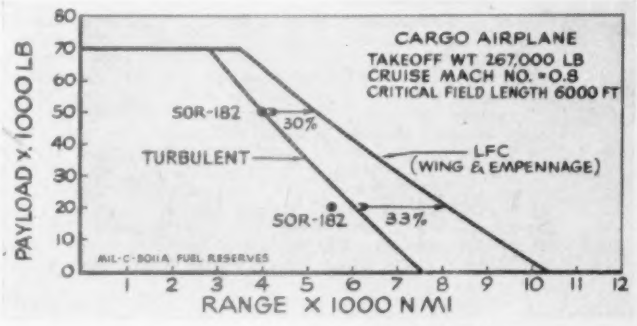


Direct operating costs of a family of LFC designs compared with a series of similar non-laminar aircraft, showing reductions from 17% to 30% according to range.

expected to include higher aspect ratios to lessen induced drag; general aerodynamic clean-up and better streamlining; and the application of LFC to the fuselage and other turbulent areas.

In the supersonic field, Northrop is continuing, under U.S.A.F. contract, research into the effects of LFC on bodies and wings at high Reynolds number in wind-tunnel tests at Mach 2.5 to 3.5. Laminar flow on a supersonic transport is of potential advantage in reducing skin temperatures as well as friction drag. At Mach 3.0 at 75,000 ft. LFC could reduce the equilibrium surface temperature by as much as 100° F. to keep the surface temperature of a large portion of the wing below 350° F.

Applied to a Mach 3.0 transport with a design range of 3,500 naut. miles, LFC could reduce the take-off weight by 60,000 lb. or increase the range by 700 naut. miles, because of a 24% reduction in total drag; most of this saving would be in friction drag.



Payload/range characteristics of two aircraft designed to meet the MATS SOR-182 specification—one with LFC and one non-laminar.

Noise Discussions at the N.P.L.

FOR three days last week, a particularly important topic—the control of noise—was debated in a conference at the National Physical Laboratory. Some two dozen papers were presented by various authorities to cover all aspects of a subject which has come to be one that involves nearly every aspect of modern life in which any sort of progress is almost inevitably accompanied by more noise.

The Conference was opened by Sir Gordon Sutherland, director of the N.P.L., assisted by Mr. Denzil Freeth, Parliamentary Secretary to the Minister for Science. Mr. Freeth made a special point of welcoming the many delegates and lecturers from overseas. The deliberations of the Conference would, he said, be of great help to the committee set up just over a year ago by Lord Hailsham as Minister for Science, to examine the problem of noise, its nature, sources and effects, and to advise on measures that might be taken to mitigate the noise nuisance.

This was, of course, essentially a conference to survey the whole area of technology covered by the heading. It included discussions and demonstrations of the fundamental problems involved, mechanical noise and its control at source, industrial noise problems, and the effect of noise on the community at large. With such a full programme, it was only to be expected that the discussions of aeronautical noises could represent only a comparatively small part of the total proceedings. In fact, out of the 25 papers that were read, only four were directly related to aircraft and aero-engines.

Nevertheless, it was not surprising that aviation came in for some criticism on the score of being a fairly healthy noise-producer. Even so, charges that in the aircraft industry no attention is paid to the noise problem in the design stages were vigorously denied. Equally vigorously, it was made plain that operating economy could not be entirely overlooked when devising the measures to take—such as using lower thrusts or restricted weights—in order to reduce take-off and climb noise in the vicinity of airports.

Introductory Views

Right at the start of the Conference, delegates were treated to an excellent statement of the general problems associated with the control of noise. This was by Mr. D. W. Robinson, of the N.P.L., who introduced his paper by remarking that the Conference was meeting at a place "steeped in traditions of 60 years of research in the precise physical sciences." This precision, he went on, had not meant a narrow concentration of effort—the work of the National Physical Laboratory covered an enormous range of application and "service to the community" was its prime charge.

It was highly appropriate, he suggested, that the first full-scale conference in the new Glazebrook Hall at Teddington (the old Duplex wind-tunnel building reorganized into a handsome lecture hall and cafeteria in contemporary style) should be devoted to a subject where scientist, engineer, architect, social worker and legislator have common and urgent problems.

There can be no doubt left in anyone's mind these days that the question of noise abatement has slowly become a major social problem of paramount importance. Mr. Robinson suggested that complex factors have contributed to this. "New inventions, especially the jet engine," he said, "have brought into existence bigger noises than man has previously been able to create. Perhaps the obvious impossibility of living at close quarters with such devices has triggered off a sort of chain reaction down the noisiness scale so that even domestic refrigerators now have their share of critics on grounds of noisiness."

Again on the subject of aeronautical noise, Mr. Robinson made the point that the technical difficulties were such that it "looks as if we shall have to live with the aircraft noise nuisance in something like the state to which we have allowed it to develop." And he expressed a fear that is shared by a good many people when he said that in aircraft design "where at the moment big money is being spent in future planning against noise" the design of a new machine of spectacular performance would not be turned down simply because it made an enormous noise.

After referring to the shortage, in the U.K., of technically trained people in the acoustical sciences, Mr. Robinson went on:—

"Other countries, such as Germany and U.S.A., are much better off than we are in the academic attention they give to acoustics and noise; and our own defects in this respect emphasize . . . that noise is always being treated as a secondary question, peripheral to some other activity which has become better organized—telecommunications, aeronautics or physiology. The time is surely ripe for the acceptance of noise control as a subject which has 'arrived,' and for a better centralization of thought and research work in the subject."

Reduction-scale Perspective

To illustrate the difficulty of achieving worth-while reductions in noise level, Mr. Robinson quoted some most interesting figures. "A 10% change of noise energy," he said, "is detectable only with difficulty under ideal listening conditions. A 50% change is noticeable but unremarkable. A reduction of 90% just about halves a noise subjectively; and to get a marked reduction, like that of closing a well-fitting door, the noise has to be cut by about 99%.

"This difference of scale has wide repercussions. An increase from 1,000 to 1,100 ft. at a point under the take-off path might, perhaps, be negotiated with an airline operator, although under present-day conditions this could well involve a payload penalty. You would hardly be able to hear the difference. To halve the noisiness, the plane would have to fly at 3,000 ft. which would probably be out of the question."

This problem of airport vicinity noise from airborne aircraft was amplified by Prof. F. Ingerslev of the Royal Technical University, Copenhagen, in his most interesting lecture: "Aircraft Noise and the Community." This analysed the method of alleviating these noises by means of selected take-off profiles and quoted the procedures adopted at Copenhagen airport.

Prof. Ingerslev said that thorough analysis of the problem showed that the overall sound pressure level does not give sufficient information about the physical characteristics of the noise to enable prediction of the response of a community. For this it is most important to know the frequency distribution of the sound. The "duration" of the noise is of importance when evaluating the disturbance caused. The number of noise exposures might be important, but there is insufficient knowledge to correlate number of flights and disturbance. The time at which the noise exposure occurs is also important. All these factors and others would need to be studied before it would be possible to predict a community response satisfactorily.

There was, said Prof. Ingerslev, a tendency to use 110-112 PNdB during day-time and 100 PNdB at night as maximum acceptable noise level values. He felt that when designing new airports a worthy aim to keep in mind would be 80 dB during the day-time and 60 dB at night.

Another sort of airport noise—that arising from the testing of aero-engines on the ground—was discussed in some detail by Mr. W. C. Copeland in a paper: "Reduction of Noise from Ground Running Aero-engines." This, of course, is a noise that may also affect areas other than those around airports where, for instance, manufacturers' test-beds may be sited. Mr. Copeland's paper provided a great deal of information on the noise problem in relation to various types of test-bed, and ground muffling and screening techniques.

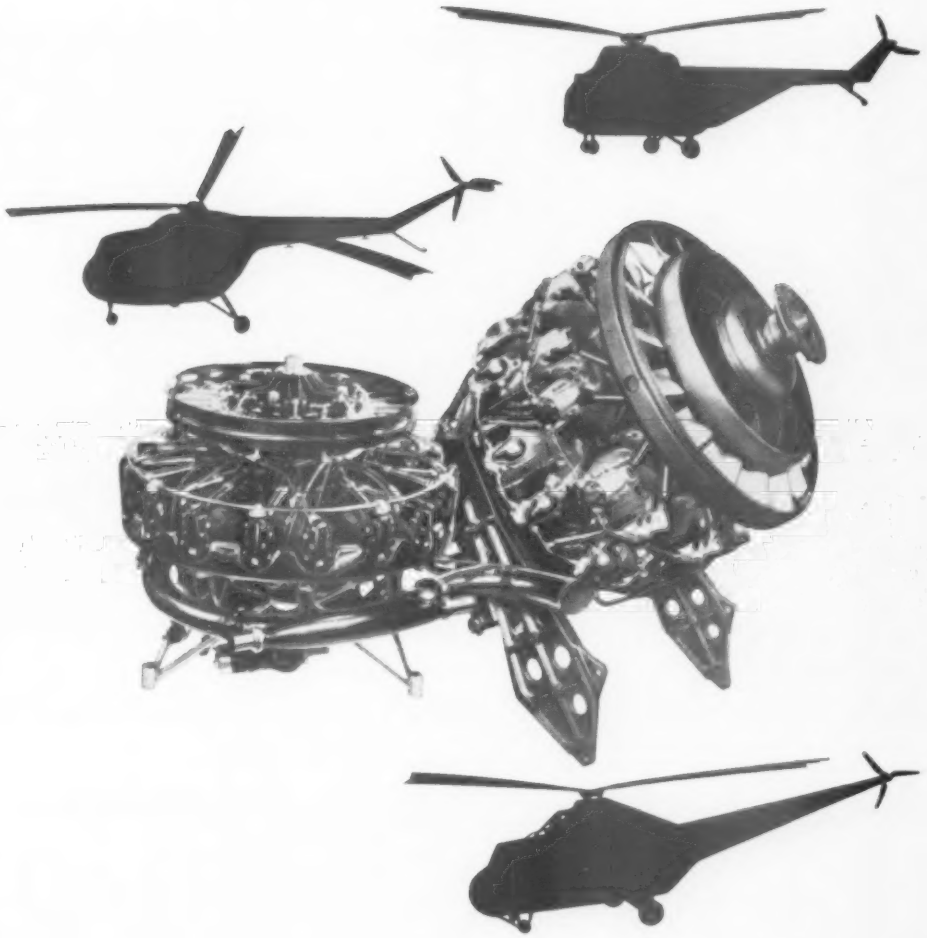
The Cost of Noise Suppression

The problem of controlling noise at source was dealt with in a paper by Mr. T. J. Hargest of the N.G.T.E., on "Jet Engine Noise Reduction." In his introductory remarks he made the point that the present generation of large turbojet aircraft makes use of engines developed from noisy military powerplants. The use of noise suppressors and/or the regulation of the amount of thrust used during certain stages of flight had led to a reduction in performance and an increase in operating cost. For the 200 or so heavy jet transports used throughout the World, the cost of the noise control measures adopted amounts to nearly £1,000,000 each year.

Mr. Hargest explained the advantages to be gained, on the score of noise reduction, by having by-pass engines of high by-pass ratio. He made the nice point that with the introduction of jet engines there was a general lessening of aircraft noise—on the ground—because of the much higher altitudes at which they were operated. This trend of reduction will, he said, be continued with the lowering of landing and take-off noise.

It was left to Prof. E. J. Richards of Southampton University to provide a dissertation on the nature of the problems under discussion. His paper "Aerodynamic Noise Sources" offered a useful review of the underlying acoustic technicalities and provided a welcome summary of the types of sound sources met with in aeronautics.—F.T.M.

Alvis Leonides engines power the Westland Whirlwind Widgeon and Sycamore Helicopters.



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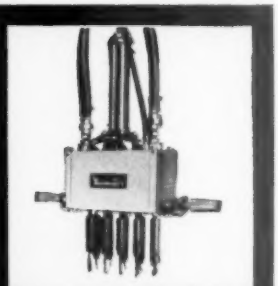
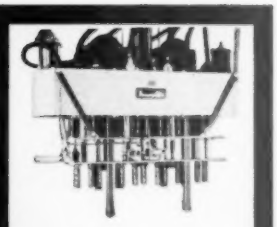


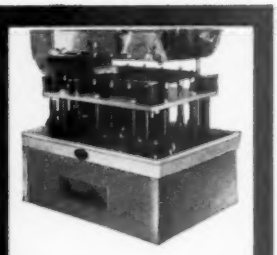
A Desoutter multi-studrunner plants 9 studs into an Austin cylinder block.

CHOUF!



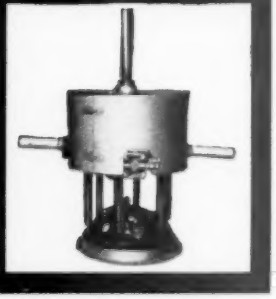
A Desoutter multi-nutrunner fixes 25 nuts on a Ford diesel cylinder head.

CHOUF!



A Triumph Herald sump is put on by a Desoutter 16-spindle multi-nutrunner.

CHOUF!



A Desoutter multi-nutrunner assembles a Vauxhall clutch plate, or tightens the wheel nuts on a Rootes Group car. And so it goes on: the Desoutter CHOUF speeds mass-production, makes sweet music in industrialists' ears. And no wonder—everyone has a taste for that sort of music—and nearly everyone has something to play it on! CHOUF! (on a carburettor)... CHOUF! (or a light fitting)... CHOUF! (or a washing machine)... CHOUF! (or anything else that needs assembling).

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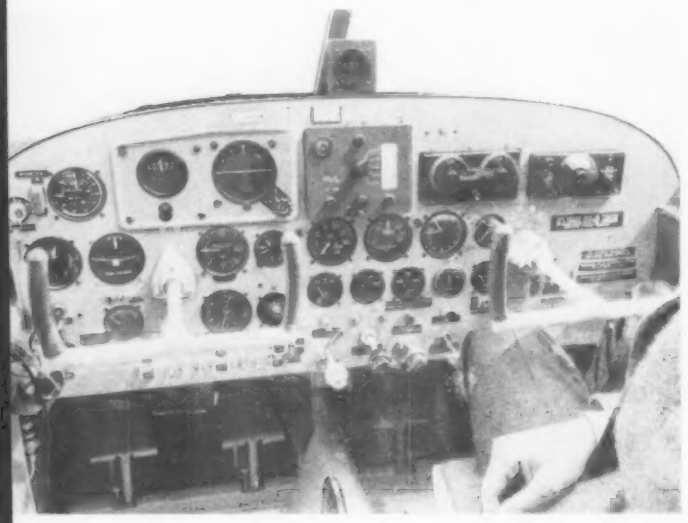
Flying the Santa Maria

No. 100 in the series by John Fricker

THIS report on the Lockheed-Macchi Santa Maria is something of a milestone for me, since it is the 100th flight assessment I have contributed to THE AEROPLANE AND ASTRONAUTICS. We have published about 165 such articles since the end of World War II by half a dozen or more contributors, but I hope I may be allowed slight satisfaction in having written the bulk of this total and perhaps more than any other pilot-author in the same line of business.

For this, more tribute is perhaps due to the forbearance and fortitude of our readers than to any personal qualities, but at least the opportunity of handling such a wide variety of types from more than a dozen countries has afforded a remarkably broad basis for comparison. In the case of the new Lockheed-Macchi project, it has very few competitors in its class as a six-seat or 1,500-lb. cargo utility aircraft, but by any standards it appears to be an efficient and economical vehicle.



Exclusively American instrumentation is used for the LASA 60's panel which—although full—is neatly arranged.

It is also extremely cosmopolitan. The basic design originated with Lockheed in 1958, before being completed soon afterwards in that company's Georgia Division by the Mooney brothers, from requirements framed by Gen. Juan Azcarate in Mexico. Its designation—LASA 60—is derived from the Lockheed-Azcarate S.A. company, formed to market the design internationally, and its year of completion. The first two prototypes were built by Lockheed for F.A.A. certification, but production is being undertaken by local industries in areas with requirements for bush-type operations.

The LASA 60 is now being produced at three centres in Central and South America and Europe. First of the facilities for the LASA 60 was the Lockheed-Azcarate plant at San Luis Potosi, about 200 miles north of Mexico City, while production is also beginning at the new Aviones Lockheed-Kaiser plant in Cordoba, Argentina. Ten LASA 60s, renamed Santa Marias, have already been built at the third factory, operated by Lockheed-Macchi at Varese, Italy, and some of these have already undertaken demonstration tours in Europe and the Middle East. In the latter area, interest has been shown by military operators, including the Moroccan and Saudi Arabian air forces.

The prototype LASA 60, XB-GUZ, was produced with a 260 b.h.p. Continental IO-470 flat-six engine, but the intention is to offer the aircraft in standard form with a similar powerplant fitted with a 38 lb. AiResearch exhaust-driven turbo-supercharger to maintain take-off power to a height of 12,500 ft. The new Continental TSIO-470-G engine has now been certificated, and has successfully completed its trials in the second prototype LASA 60, N601K. With 35 in. Hg boost available for take-off and climb at 2,600 r.p.m., the turbo-supercharged LASA 60 in standard form offers exceptionally good performance in high altitude and ambient temperature conditions.

Two Santa Marias were shown at Le Bourget during the recent Paris Salon by Lockheed-Macchi, one furnished for six passengers and the other stripped for freight. The second and third aircraft of their type produced at Varese, they were produced for a crop-spraying contract with an Italian company, and were fitted with the unsupercharged IO-470 engines. The remaining eight machines of the initial Italian contract are the standard supercharged types, and a further 15 are being produced to an American order at a rate of one per week.

My introduction to I-PFOR, with its six lightweight and quickly removable seats, was from Col. Fatigati of the Macchi company. The functional all-metal angularity of the Santa Maria reminded me of the Pilatus Porter, which has already earned a name for itself in a slightly heavier utility category. The long rectangular inner sections of the mainplanes accommodate Fowler-type flaps of unusually large size, amounting to almost one-fifth of the wing area, as essential aids to short-field performance.

Less normal, for a utility aeroplane, is the installation of a nosewheel undercarriage, although in the LASA 60, this has several unique features. The main legs are high-tensile steel tubes which are swept back at 45 degrees and also extended outwards for a very wide track. They are individually snubbed on rubber (disc) trunnion plates, but despite the lack of a complex shock absorber system, the landing gear, with its trailing steerable nosewheel, gave an exceptionally well-cushioned ride on Le Bourget's rough grass.

Access to the box-like cabin is via a passenger door on the port side, and a similar door inset in a 4½ ft. by 3½ ft. cargo hatch opposite. The heavy duty floor is flush with the cargo hatch sill, and is sealed, despite its movable tie rings, for rapid cleaning. Some idea of the cabin capacity of the Santa Maria is given by such typical loads as: three yearling steers; an eight-foot boat, with motor and camping gear; or two stretcher patients plus a medical attendant.

The LASA 60 is uncritical about C.G. for loading, having a 13 in. range plus a very simple system of assessing stowage

The commodious fuselage of the LASA 60 is apparent in this view of the aircraft taxi-ing on the Le Bourget runway; the stark simplicity of the main undercarriage is noteworthy. The 260-b.h.p. Continental is exceptionally cleanly cowled.

Photographs copyright "The Aeroplane and Astronautics"

On the starboard side of the fuselage is a normal door which itself is part of a large cargo loading hatch.

Photograph copyright "The Aeroplane and Astronautics"

limits. After loading, if the rear fuselage is pushed down until it grounds and the nosewheel then comes back to earth unaided, the C.G. is within limits.

For its size, the Santa Maria has one of the biggest cabins I have seen, and there seems to be at least six inches between the two rows of seats, including those for the crew. Furnishings are as sparse as one would expect from a utility type, and the deep front panel is a model of functional simplicity. The dual control wheels are merely built-up sections of steel tube, but both sets of rudder pedals have toe brakes.

I took the right-hand seat alongside Col. Fatigati, and there were three more passengers plus about two-thirds fuel to make quite a reasonable load. Fuel is carried in a 30 U.S. gal. (25 Imp. gal.) tank in each wing-root, gravity fed in accordance with the general simplicity. A single gauge with a selector switch on the panel indicates contents, and the Continental IO-470 injection engine has its usual fuel pressure/mixture indicator among the powerplant instruments.

Vernier plungers serve for throttle, mixture and pitch controls and, except for the slightly random location of some of the minor switches and levers, layout of the LASA 60 cockpit is comfortable and effective. Visibility seemed to me above-average for a high-wing aeroplane; the pilots are seated just aft of the leading-edges, and the deep front screen extends well overhead. In its stowed position, the roof-mounted manual flap lever follows the contours of the central windscreen frame where it is conveniently out of the way.

It is difficult, in fact, to fault any point of the control layout; even the longitudinal trimmer avoids the frequent American eccentricities in being a man-sized wheel mounted logically between the front seats for adjusting tailplane incidence. The exclusively American instrumentation and cockpit lettering gave no indication of the Italian origin of I-PFOR, which was also fitted with Sun Air HF, a Narco Mk. V VHF set and Motorola ADF along the upper portion of the panel.

The healthy note of the idling Continental indicated the lesser degree of soundproofing usually associated with utility aircraft. Cowl flaps were opened for the very prolonged wait at the runway threshold inseparable from the display traffic at Le Bourget. When we were at last cleared for an immediate take-off, Col. Fatigati opened up to full power for a brisk acceleration to 50 m.p.h., before dumping full flap for an unstick. The flaps have only two extended positions at 12 and 27 degrees, but despite the relatively small angle of deflection, they appeared potent.

Climb-out at 55 m.p.h. was accompanied by a blip of stall-warning horn, after a run of certainly no more than 200 yards. Before flap was raised, with a slight nose-down trim change and very little sink, the V.S.I. indicated about 600 ft./min., and power was then reduced to 28 in. Hg and 2,400 r.p.m. for a low-altitude stooge over the roof-tops of Paris. Clear of the circuit, plus its commercial traffic, we opened up to 27 in. and 2,500 r.p.m. for a further brief climb at 80 m.p.h. and 700 ft./min. over the north-eastern suburbs of the city.

The Santa Maria was handed over to me at about 1,500 ft. with 26 in. Hg and 2,400 r.p.m. power settings, cruising at about 130 m.p.h. in very indifferent weather over unfamiliar countryside. I liked the feel of it at once; it seemed very stable and solid in its flight path, and yet easily controllable with little effort. Unlike some short-field aeroplanes, it did not require vast expenditure of muscle-power to heave around. Control forces remained moderate and well harmonized, and I was agreeably surprised by the very small changes of trim throughout the flight.

As time was short, I decided to explore the slow-speed performance straight away, the small grass airfield of Cognes proving a convenient orbiting point. With not a great deal of ceiling to play with and a fairly full load on board, my approach to the stall, clean and power off initially, was cautious, but the breakaway, after a warning bleat at 65 m.p.h., at around 60 I.A.S. was no more than a gentle nod, with the wheel right back.

Flap limit speed is 100 m.p.h., and at just below that figure I reached up to pull down the lever. From past experience with manual flaps, I put quite a bit of effort in the downward pull, only to find the air loads surprisingly light. It did not seem necessary to retrim with full flap, the nose rising gently to a representative approach speed which I held with a little power. Once again, an innocuous breakaway followed the stall warning horn, which began at 55 m.p.h., and was succeeded by a slight airframe buffet before the nose dropped straight at around 45 m.p.h. I.A.S.

Some lateral control remained throughout and, with the help of small leading-edge spoilers, there was no tendency towards a wing drop. Position error adds about 8 m.p.h. to the full-flap stall I.A.S., so the low-speed performance of the LASA 60 is quite impressive. Its clean airframe imposes little penalty at the cruising end of the scale and coupled with the amount of space in the cabin led me to feel that with more soundproofing and a plush interior finish, the Santa Maria would make a very acceptable private or executive aeroplane.

As it is, farmers, bush operators and similar agencies will find many uses for this adaptable design, whose unexceptionable flying characteristics were confirmed in a semi-instrument approach back to Le Bourget. In some ways the Santa Maria reminded me a little of the Prentice, with its good-natured, slightly ponderous feel, and it is the sort of aeroplane in which pilots immediately feel at home.

This was encouraging when it came to join the milling beehive of Le Bourget, but the LASA 60 helped enough for Col. Fatigati to leave the approach and landing to me. It was barely necessary to wind the trim wheel a turn or two back after lowering flap to maintain a safe 70 m.p.h., with a little power, during an impressively steep approach, and I felt no compunction at reducing to 60 on finals. Plenty of elevator was available for a controlled and soft touchdown on the grass, and a very short landing with a touch of toe-brake.

Although my acquaintance with the LASA 60 was not quite as extensive as I would have liked for a comprehensive assessment, I learned enough in a half-hour or so to get a good idea of its considerable potentialities. Some aeroplanes leave a slightly bad taste in the mouth on initial contact, but the Santa Maria is honey all the way. The only valid criticism one could make, which presented itself during the long taxi back after landing, was lack of positiveness in the nosewheel steering of I-PFOR, coupled with slightly heavy foot loads. Otherwise, the LASA 60 is clearly excellent value at $22,000 in basic unsupercharged form, or $24,000 with the TSIO-470.

The 20-30,000 r.p.m. turbo-supercharger enables the aircraft to maintain an 800 ft./min. rate of climb up to 12,500 ft., at the normal gross weight of 3,532 lb. (max., CAR Part 8, 3,752 lb.), compared with the 275 ft./min. at that height unsupercharged. With the TSIO-470, the take-off to 50 ft. is still only 1,400 ft. at 8,000 ft. Future development of the design includes optional installation of floats or skis.

LEADING PARTICULARS

DIMENSIONS.—Span, 39 ft. 4 in.; length, 28 ft. 1 in.; height, 10 ft. 8 in.; wing area, 210 sq. ft.; wheel track, 9 ft. 4 in.

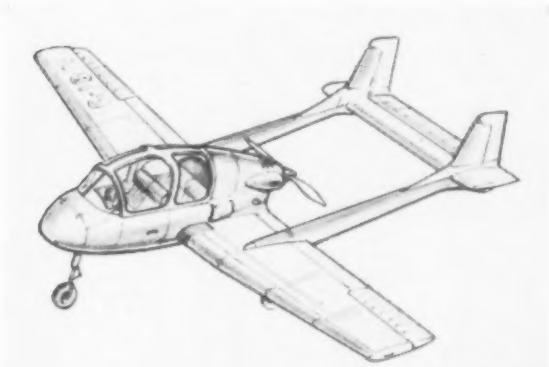
WEIGHTS.—Empty, 2,024 lb.; normal useful load, 1,508 lb. (inc. 50 Imp. gal. fuel, 360 lb.), pilot 175 lb., trapped fuel and oil 35 lb.; normal payload, 938 lb.; max. gross, 3,532 lb.

PERFORMANCE (unsupercharged version in parentheses).—Max. speed, 168 m.p.h. at 12,500 ft. (148 m.p.h. at sea-level); economical cruise, 130 m.p.h. (117 m.p.h.) at 10,000 ft.; initial climb, 1,050 ft./min. (890 ft./min.); service ceiling, 23,000 ft. (16,000 ft.); stalling speed, 53 m.p.h.; take-off distance to 50 ft., 1,050 ft.; landing distance from 50 ft., 1,045 ft.; range at economical cruise, 650 st. miles (700 st. miles).

Personal Flying

A FOUR-SEAT, all-metal light aircraft has been designed by a group of apprentices and their former colleagues from Vickers-Armstrongs (Aircraft), Ltd., at Weybridge. Known as the Velvette, the project was a spare-time venture for about half a dozen members of the group, who have gained a considerable amount of experience in the general design of light aircraft. They are now seeking financial backing for building a prototype.

The Velvette specification was drawn up in July, 1959, for a four-seater with a cruising speed of 130 m.p.h., and capable



of operating from short grass strips, for club use. Construction had to be as simple and cheap as safety would allow, and a twin-boom pusher layout stressed to semi-aerobatic standards was eventually evolved. Detail design work was distributed among the members of the group, under chief designer Brian Lawrence.

Tony Wickstead and Dave Neville supervised the fuselage design, while the wings were the responsibility of Brian Lawrence. Leon Nash designed the tailplane and elevators and Keith Paine looked after the booms and fins. Details of the nosewheel undercarriage have not been finalized, but it is to be fully retractable. Control surfaces and systems will depend largely on the result of wind-tunnel tests, which are being undertaken at Southampton University by Miss D. Lane, the group's aerodynamics expert. The tunnel model was made at Weybridge in the model shop.

Originally, a Lycoming O-360-B engine developing 168 b.h.p. at 2,700 r.p.m. was specified, but the group's interest has now turned towards a Rolls-Royce Continental powerplant.

• • •

A Cessna 310 executive aircraft was recently handed over to racing champion Jack Brabham at Luton Airport, by Capt. Ray Young, manager of McAlpine Aviation. The Cessna was bought by Brabham from Lance Reventlow, the well-known American racing driver, and overhauled by McAlpine Aviation.

Twin conversion on the Cessna was given to Brabham by Capt. Turner, chief pilot of McAlpine Aviation, and the racing driver's first trip was to Le Mans, for the 24-hour sports car event. McAlpines also assembled and overhauled another light aeroplane for a member of the racing fraternity—a Piper Comanche for Lotus designer Colin Chapman.

A fourth pilot, Capt. Hugh Watt, recently joined the McAlpine staff from Cunard Eagle Airways. The appointment of McAlpines as U.K. distributors for the Helio Courier v/STOL aircraft has now required a full-time demonstration pilot.

• • •

A flying centre for Scotland has been established at Renfrew by Capital Services (Aero), Ltd., to offer hangarage, maintenance, hire and charter facilities, plus every possible help to visiting pilots. Initially, a day and night business charter service from Scotland to England or the Continent is being provided, but a useful link service is also to be offered to other executive aircraft operators.

This would be from Renfrew or East Fortune onwards to all Scottish mainland and island airfields. Among the principals behind the scheme is Duncan McIntosh, who was formerly chief test pilot of Miles Aircraft.

Gliding Notes

by Dr. A. E. Slater

AT the last meeting of the Gliding Commission of the *Fédération Aéronautique Internationale*, the 15-metre Standard Class came in for discussion. At the first appearance of a Standard Class, at the 1958 World Championships in Poland, the German Ka-6 won the prize for the type best conforming to the objects for which the Class was instituted; and it has since justified the choice by being produced in quantity to satisfy a demand from many countries.

The Standard Austria, which won the Standard Class prize last year, is not yet being produced in quantity; but by general consent it deserved the prize, in contrast to some other entries which were considered too exotic and expensive. So the Gliding Commission has decided that Standard Class entries must be types of which a certain minimum number, such as ten, has already been sold; if only a prototype exists, it must fly in the Open Class.

Writing about the meeting in the Swiss *Aero Revue*, Karl Ruckstuhl raises the question whether Open Class as well as Standard Class pilots should be forbidden the use of radio, so that the "real World Champion" can be identified. This is an evident hint at the way the two leading Polish pilots last year flew together in constant radio contact, so that if either had become Champion, the real credit would have been due to both, because of the advantage they derived from co-operating. But much of their co-operation was visual, and no regulations can prevent World Championship pilots from looking around to see who has the best lift.

Another question raised at the Commission's meeting was that of facilitating the crossing of frontiers by airborne gliders. Ruckstuhl mentions news of a proposed easing of restrictions between Austria, Czechoslovakia, Italy and Yugoslavia. This would indeed be an example to less heterogeneous groups.

He also mentions the continued filching of airspace from private aviators as an evil to be countered by international co-operation. To quote Lord Brabazon's remark during the prizegiving at our own Championships: "I have seen something that was a sport become an armament and then a method of transport which is so proud of itself that it wants to bag all the air in the World."

• • •

BRIAN MASTERS, who took a job early this year as chief instructor at the Briegleb Soaring School in California, finds that his site at El Mirage often lies under the same wave system as the famous wave site at Bishop, 200 miles to the north, probably because of a southward extension from the Sierra Nevada range which sets off the Bishop Wave. In fact, Paul Bikle has already made use of this southward extension in putting up his recent World's height record of 46,267 ft., though he started from farther north near Mojave, and his wave cloud did not stretch all the way to Bishop.

Believing that it should sometimes be possible to soar cross-wind all along the wave from El Mirage to Bishop and back, Masters set out on May 2 at 07.00 hr. in a Cessna 182 with Gordon Wheeler, who owned it, and another pilot, Phil Troutman, to explore the route. Flying across a N.W. wind, they contacted a weak desert thermal at 07.45 and then wave lift at 07.55 as they entered the deep valley just to leeward of the Sierras at 8,500 ft. Soon, flying at 125 m.p.h. at 40% power, they were climbing at 1,200 ft. per min. to 18,500 ft. Here they looked down on the remarkable sight of a wall of sand and dust rising to at least 12,000 ft. after being stirred up by "the edge of the wave bouncing on Owen Dry Lake."

Next, they found a rotor cloud, with its base at 16,500 ft., and edged near enough to feel severe turbulence. At Bishop the wind blew at 60 m.p.h. from the west. Here they turned about and flew back to El Mirage, in wave lift for the first 100 miles, then through thermals, and landed at 10.15 after using 28 gallons on a flight that, in the absence of upcurrents, would have needed 43 gallons.

Evidently on this day, for a 400-mile out-and-return to Bishop and back, thermals would have had to be used on the southern half of the route, but high speed could have been made along the wave in the northern half. However, they do get waves at El Mirage, for in early May Gordon Wheeler reached 26,500 ft. in one, and could have gone higher but for the cold. Brian Masters also has climbed from 1,000 to 10,500 ft. in wave lift there in a TG-3 trainer with a pupil. But the machine has reached 12,000 ft. in thermals.

Industry Record

Component Testing by B.O.A.C.

In our previous issue, we briefly recorded the inauguration of B.O.A.C.'s new test-house at London Airport for the testing, after overhaul, of air conditioning, pressurization and electrical power generation components for the Corporation's turbojet and turboprop fleets. Some of the equipment available for this work is described below.

In the new test-house, compressed air for the test equipment is supplied by five Howden rotary screw-type units giving air at up to 18 atmospheres and at up to a maximum flow rate of about 300 lb./min. These compressors are driven by 380-550 b.h.p. Laurence Scott electric motors. The air is cooled before use, by a refrigeration plant, to remove excess moisture and is then heated to the appropriate test temperature by one of two A.E.I. 1,000-kw. heaters.

An automatic central control system supplied by Honeywell Controls, Ltd., directs air to one or both of the two main supply systems; and any two of the three test cells can receive air simultaneously. After use, the air is discharged outside the building through Cullum silencers.

In addition to the three cells used for testing air-powered components, a fourth is held for future test requirements, such as the mechanically driven cabin air compressors for the VC 10. A fifth cell is used for testing electrical components.

Mains electrical power is used for driving components under test. It is said to constitute a maximum load of 4.5 megawatts—equivalent to the whole of the electrical power consumed in the rest of B.O.A.C.'s headquarters at L.A.P.

Air conditioning units tested at this new plant include cold-air units and control valves for the Boeing 707s, Comets and Britannias and turbo-compressors and starters for the 707s. Electrical equipment to be dealt with include transformer-rectifier units and alternators for the Britannias; alternators and Sundstrand drives for the 707s and VC 10.

Turbine Equipment Sales

With the receipt of their latest orders from the Royal Navy, the R.A.F. and aircraft manufacturers for low-pressure air starters and airborne power units, Blackburn Engines, Ltd., announce that they have achieved sales of over £3 million for this type of turbine equipment. This is in addition to sales of other small turbines, the latest of which is the Nimbus, a free-turbine in the 1,100-e.p. range, for which large orders have been received to power the Westland Scout helicopter.

Rotary Shaft Seals

For high-speed shaft sealing applications where axial space is at a premium, Flexibox, Ltd., of Manchester, have developed a new mechanical seal—the Type DD. This unit is stated to be capable of coping with peripheral speeds up to 15,000 ft./min., pressures up to 1,000 p.s.i.g. and temperatures up to 500°F. All the components are replaceable and worn parts can either be replaced completely or reconditioned without destroying the whole seal.

The Flexibox Type DD is a face-type balanced mechanical multi-spring seal. It consists essentially of a housing which carries a resiliently mounted stationary rubbing face assembly consisting of a body insert and resilient packing. Face loading is provided by a number of small springs arranged around the flange of the stationary seal ring body. This ensures close control and uniform application of the face contact pressure.

Three variants of the basic design are available—O-ring fitted, chevron packed and "reverse balanced," respectively. In addition, each basic type is available in two ranges of axial tolerance and three face loadings. Typical applications include aircraft fuel pumps, helicopter mechanisms, gas turbine shaft bearings, gearboxes, rocket engines using liquid fuels and oxidants and hydraulic pumps and motors.

New Anglo-American Company

The General Electric Co., Ltd., and Thompson Ramo Wooldridge Inc. (TRW), of Los Angeles, have formed a new joint British company—with headquarters in London—to market industrial process control systems in Great Britain, the European Free Trade Area and the Commonwealth. The new company, known as International Systems Control, Ltd., will start with a capital of £430,000 equally shared by the parent companies.

Ground Equipment Merger

Petbow, Ltd., of Sandwich, Kent, have taken over Vernons Industries, Ltd., Liverpool factory and all the manufacturing rights on their range of aircraft ground starting and servicing equipment, high-frequency alternators, converters, etc.

NEW PLANT.—Part of the new Texas Instruments factory in Bedford, designed specifically for the production of semi-conductor devices including transistors. It was formally opened on Jne. 27 by Sir John Cockcroft.

During the past 10 years Vernons have built up a considerable business in the design and manufacture of all types of 400-cycle aircraft ground servicing and starting equipment for Service and civil aircraft, together with a wide range of equipment for the testing of generators, etc. Over the same period Petbow have concentrated on production of both mobile and stationary AC generating equipment from 3-500 kW.

Fuelling Test House

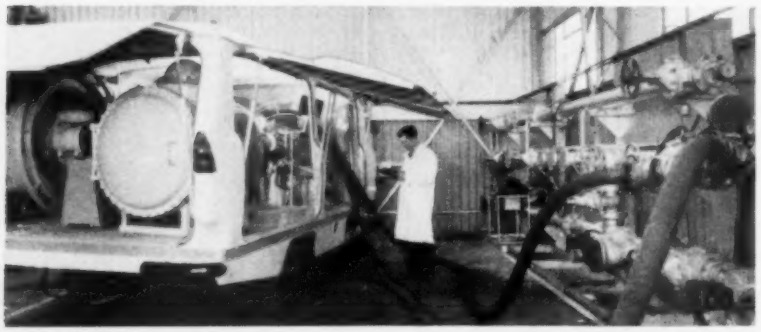
A new test house has recently been opened by Zwicky, Ltd., at their main works in Buckingham Avenue, Slough. It has been built and equipped for testing in simulated field operating conditions all the Zwicky company's products, including equipment such as aircraft refuellers and hydrant dispensers.

The test house has two fuel tanks, with a total capacity of 10,000 gallons, a fuel "loading" rack and a 6-in. dummy ring-main pipe line. This enables shock or surge in hydrant mains to be studied at stations which have been incorporated for this purpose. Similarly, the performance characteristics of components can be evaluated by means of special test rigs.

The flow in the test house is measured with orifice plate meters designed and manufactured to BS.1040, and with positive displacement meters; multi-pen recordings are made. Stations have been provided for measuring the flow and the effects on components of heavy oil, hydraulic oils, etc. A special rig has been provided for testing pressure control valves.

Other stations in the test house provide for testing the company's standard range of products, which are designed for handling aviation fuels and other hydrocarbon products such as diesel oil, fuel oil, solvents and lubricants. The return flow line passes through two 10-micron filters with a combined capacity of 1,000 g.p.m. in order to maintain the fuel in a clean and healthy condition.

Various safety devices are also employed, including emergency pressure bursting discs across the pipe lines to permit the escape of fuel developing pressures in excess of those for which the equipment is designed, without damaging the equipment.



A BP Angus Superjet fuel dispenser built by Zwicky, Ltd., undergoing final tests in the new test house recently built and equipped by Zwicky at their main works in Buckingham Avenue, Slough.

Correspondence

Semi-centennial Congratulations

From Sir William P. Hildred, Director-General IATA

AVIATION moves so rapidly that one doesn't always see the milestones along its course, but some of them are important and must be noted, even ex post facto. The semi-centennial of THE AEROPLANE is certainly one of these and I trust it is not too late to send you hearty congratulations on the first 50 years and best wishes for many, many more to come.

I know that these sentiments will be shared by the legions in the airlines to whom THE AEROPLANE was their primer in the business and who still find it an indispensable weekly vade-mecum. Through all these years it has been something special: a mirror which puts us all in the proper perspective, a recorder, guide, commentator, critic, goad—but always an understanding and enthusiastic friend, who has not hesitated to speak roughly to us when we needed it.

One could not say these things, or mark this anniversary, without thinking of C. G. Grey, or of paying tribute to the way in which his successor has applied the same policies to the conditions of a greatly changed world. As our industry grows and attracts increasing numbers of young men and women, this long editorial tradition of knowledge, understanding and plain speaking is one of its greatest assets.

Montreal. WM. P. HILDRED.

Good Educational Value

HAVING been away from the office for the past week, I have only just seen the Golden Jubilee number of THE AEROPLANE and I hasten to congratulate you on this not inconsiderable event.

When I saw the Bristol Aeroplane Company's advertisement opposite the leader page, I was reminded that in 1911 the price of the paper was such that I as a young schoolboy could afford to take it weekly and I think it was the cheapest form of education I ever received. I am sure that if C.G.G. had been conscious of the value of the wisdom which flowed weekly from his pen in those days, the subsidy from the Sassoons would not have been necessary!

London, W.1. L. A. SWENY.

Jubilee Congratulations

WE are unable to publish all the letters we have received on our Jubilee. If any writer should not have had a letter of thanks, this opportunity is taken of putting our appreciation into words and reciprocating the sentiments so warmly expressed.

London, E.C.1. THURSTAN JAMES.

Wanted, a Publisher

FOR more than 30 years I have enjoyed reading THE AEROPLANE, and the Golden Jubilee number I found especially enjoyable. But, Mr. Editor, what is the matter with publishing houses that they do not jump at the opportunity of publishing our great "C.G.G.'s" "Bats from My Belfry"?

After reading the two instalments published in THE AEROPLANE AND ASTRONAUTICS I am sure that all who read the "A and A" would jump at the chance of being able to add this book to their libraries. Cannot some of his old friends show some publisher the error of his ways?

With best wishes to THE AEROPLANE AND ASTRONAUTICS.

Somerset. DONALD MOUNTER.

The Schneider Trophy for the Air Ministry

IN the House of Commons on Jne. 13 Dr. R. F. B. Bennett (Cons., Gosport and Fareham) suggested to the Secretary of State for Air that, in view of the fact that it was won by a R.A.F. pilot in a R.A.F. aircraft, he should ask the Royal Aero Club to lend the Schneider Trophy for exhibition in the entrance to his Department. Mr. Julian Amery promised to consider it.

This strikes me as a proposal well worth following up. For the record, it is now just 30 years since Great Britain won the Trophy for the third time in succession, to gain permanent possession in accordance with the conditions; to be accurate, this final win was by a walk-over (or fly-over?), no other contestants materializing.

The Trophy, a massive affair of aesthetic design and beautifully worked in oxidized silver—it is intrinsically valued at over £1,000—was presented in 1913 by M. Jacques Schneider, a French patron of aviation, for contest over a closed circuit by seaplanes of all nations. The first race, in 1913, was won fittingly by France (speed 45.75 m.p.h.), and of the following 10 contests up to and including the last in 1931, Great Britain won five, Italy three and U.S.A. two. The winning British aircraft in 1922, 1927, 1929 and 1931 were all designed by Mitchell.

Some of us over the years have come to regard the Schneider Trophy as a piece of furniture indigenous to 119 Piccadilly. While familiarity with such an *objet d'art* could surely never

Groundabout

Close Enough. Aviation Traders' ATL-98 Carvair prototype came through its first test flight in fine style, all things considered. After a satisfactory two-hour flight, it landed, British United Airways tell us, "within 3,500 ft. of the 5,265-ft. long O6 runway at Southend." Among the technical Press, speculation on the flight's final stages is, as they say, rife.

*

G.T.O.L. Remember last week's pictures of a Japanese "man-powered hovercraft" and my guesses about what G.T.O.L. in their caption might mean? Deputy editor Freddie Meacock now adds *his* exotic interpretation:

"Far Eastern charm is not so dead
that Western letters can be read
as words with meanings far remote
from Oriental fountainhead.

Although applied to muscle drive,
G.T.O.L. cannot thrive
as euphemistic word or phrase
until its message can arrive.

G for *Gracious* static station;
T for *Test*, without ovation;
O for *Of* without a doubt;
L then must be *Levitation*."

*

High Pressure Ear? Paris Show stories are still coming in. R.A.E. Farnborough's Beverley, which took over Short SC.1 equipment, needed some slight maintenance and an Armament Flight pilot who went along as interpreter asked the French ground staff for some high-pressure air for the Beverley's oleos. Ten minutes later, our interpreter was in the Le Bourget Sick Bay, bewildered and wondering why the French wanted to syringe his ears.

*

Fun Finding Out. Let me recount the Case of the Missing Choppers. A year or more ago, the Moroccan Government ordered and received two Hillers—no spares, no instructions for the use and care of, no crew, no engineers—they just wanted two helicopters, period. Since then, in spite of company inquiries, silence. Unable to stand the maddening uncertainty any longer, Hiller's have sent a sales engineer there. If he can't trace either body, I suggest he tries, say, Monaco—or Maraca, in Brazil, or Maracay, Venezuela, or even Mexico. Anything can happen in aviation.

*

BOAC may not be able to *charge* like the railways, but we sure know the drill in other directions.

by Grog

Correspondence . . . .

breed what familiarity is commonly said to breed, nevertheless its presence has largely come to be accepted as a matter of course. A temporary translation to the august protection of the Air Ministry would, I believe, afford a welcome change of air to the Trophy itself and enable other admirers, new and old, to make and renew its acquaintance.

Uxbridge. O. W. H. COOKE.

Farnborough at Gatwick?

WHY not hold the annual air show at Gatwick which is so much more accessible by public transport than Farnborough? Presumably similar air traffic arrangements could be made as in Paris when Le Bourget is used for the French show.

If a great exhibition hall were constructed at Gatwick it could be used not only for the air show but also for the motor show and then traffic in West London would be less chaotic than it is when thousands of cars block the roads within a mile radius of Earls Court. Gatwick has road approaches adequate for the three public days, and presumably British Railways could cope. Or couldn't they? If one lingers late at Farnborough on a "caravan crawl" one's had it, unless a private car is available. And those who have been "caravan-crawling" would be safer in a train.

London, W.14. GEOFFREY DORMAN.

Fun to Fly and to Build

I WAS interested to see the series of pictures of my light autogyro in THE AEROPLANE AND ASTRONAUTICS for Jne. 22.

I have no doubt that the unfortunate registration letters have been noted by your readers—and combined with the last picture to give rise to ribald comment!

The machine was based on the Bensen Gyrocopter and had been flown successfully for some months prior to the incident mentioned. It was built in a bedroom over a period of 18 months of dedication and self-denial. It is quite easy and normal to fly—though the business of getting the rotor up to speed for take-off can lead to much embarrassing wet-henning around the airfield. I would say that a rotor speed-up device is a must for this type of aircraft.

The unfortunate engine cut was attributable to a shortcoming in fuel tank design—and not to any defect in the excellent McCulloch engine. A modification is in hand. The rough landing was due to an over-enthusiastic check of descent from an awkward altitude. The damage, apart from a written-off rotor, was slight.

For the benefit of those who might be tempted to take on similar enterprises—even the most modest flying is the greatest fun in something you have created yourself. It is well worth the effort—and the odd setback!

I should mention also that the A.R.B. is most co-operative in the matter of obtaining the Permit to Fly.

Shoreham-by-Sea, Sussex. J. S. SPROULE.

Bristol 188 Credits

MR. A. W. GREGG'S letter, "Credit Where Due," printed in your issue of Jne. 22, presents a point of view to which many designers do not subscribe. They feel that an integrated system of cabin air conditioning and pressurization only adds to the many variables which make accurate control of either system difficult.

They therefore prefer not to put all their eggs in one basket and, as in the case of the Bristol 188, to use a separate system to control the temperature of the air in the cabin.

Teddington Aircraft Controls are therefore supplying for the Bristol 188 their well-proven system of pneumatic cabin temperature control by which the amount of hot or cold air to maintain a required temperature is sensed by a Teddington sensing element, metered into the cabin by a Teddington overheat controller.

The result is a self-contained, compact unit capable of operation at temperatures as high as any which are foreseen in modern supersonic aircraft.

Checking on your list for Bristol 188 in the issue of May 11, it would appear that the credits are a little confused. It would be correct to say "Teddington Aircraft Controls, Ltd., Air Conditioning Equipment" and "Normalair, Ltd., Pressurizing Equipment" and honour would be satisfied all round.

Merthyr Tydfil, Glamorgan. C. C. HOBSON.

Aviation Calendar

Jly. 6

Rome-Turin.—Italian Aero Club International Aviation Contest; until Jly. 8.

Jly. 7

Cranfield.—The College of Aeronautics Presentation Ball, at the College, at 22.00 hrs.

Jly. 8

Vittel.—Vittel Aero Club Doctor-Pilots' Rally; until Jly. 9.

Jly. 11

Southampton.—The University of Southampton Department of Aeronautics and Astronautics' Seminar on Astronautics; until Jly. 19.

Jly. 12

London.—The Kronfeld Club lecture. "Development of Vertical Take Off Aircraft," at 74 Eccleston Square, S.W.1.

Jly. 13

Baginton.—The Coventry Air Pageant; until Jly. 15.

Jly. 14

Mejane.—Marseilles-Provence Aero Club Rally; until Jly. 15.

Angers.—Angers Gliding Week; until Jly. 23.

Company Notices

NEW COMPANIES

Airway Hotels Investments, Ltd. (695,277).—Private co. Reg. Jne. 12. Cap. £1,000 in £1 shs. Sols.: Tringhams, 23 Portman Square, W.1.

Hampshire Aeroplane Co., Ltd. (695,465).—Private co. Reg. Jne. 14. Cap. £100 in £1 shs. Manufacturers, designers and constructors, hirers, repairers and reconditioners of and dealers in aeroplanes, helicopters, etc. Directors: Vivian H. Bellamy and Mrs. Louie Bellamy, both of Green Gables, Holly Hill Lane, Sarisbury, Hants. Sec.: Robert W. Cross, Cholderton House, Ashurst, near Southampton.

Lutair Handling Services, Ltd. (695,341).—Private co. Reg. Jne. 13. Cap. £1,000 in £1 shs. Aircraft, passenger and freight handling facilities. Directors: Gerald H. G. Threlfall, 32 Park Farm Close, N.2; Edward J. Posey, 21 Farm Avenue, N.W.2. Sec.: Sally D. A. Nolder. Reg. off.: 26 Dorset Street, W.1.

Ringway Technical Activities, Ltd. (695,478).—Private co. Reg. Jne. 14. Cap. £2,000 in £1 shs. Manufacturers of and dealers in, hirers, repairers, maintainers and servicers of aeroplanes. Directors: John B. Treacy and Margaret Treacy, both of 7 Linden Grove, Manchester, 14. Sec.: J. B. Treacy. Reg. off.: 40 Brazennose Street, Manchester, 2.

CHANGES OF NAME

Joseph Lucas (Gas Turbine Equipment), Ltd. (93,633).—Well Street, Birmingham. Name changed to Lucas Gas Turbine Equipment, Ltd., on Nov. 1, 1960.

Charles Butler Associates Design for Industry, Ltd. (597,231).—Aircraft interior designers, etc. 72 Wigmore Street, W.1. Name changed to Product Design Associates, Ltd., on Nov. 24, 1960.

INCREASE OF CAPITAL

Hunting Aviation Management, Ltd. (391,811).—The Airport, Luton. Increased on Oct. 6, 1960, by £600,000 in £1 ordinary shares, beyond the reg. cap. of £1,050,000.

New Patents

APPLICATIONS ACCEPTED

874,486.—**S. Smith and Sons (England), Ltd.**—"Servo systems."—Jly. 23, 1959. (Jly. 25, 1958).

874,829.—**Soc. Nationale D'Etude et de Construction de Moteurs D'Aviation.**—"Vertical take-off and landing aircraft."—Jne. 30, 1958. (Aug. 14, 1957).

874,845.—**Hispano Aviacion S.A.**—"Means for controlling the stability of an aircraft."—Oct. 15, 1957. (Mar. 7, 1957).

874,496.—**R. Wesley.**—"Jet propulsion nozzle noise suppression means and thrust reverser."—Aug. 27, 1958. (Aug. 30, 1957).

Printed specification of the above will be available on Aug. 10, 1961, and the opposition period will expire on Nov. 10, 1961.

Personal Notices

BIRTHS

Blockey.—On Jne. 18, at R.A.F. Hospital, Ely, to Gillian Gayle, wife of Flt. Lt. John Blockey—a daughter.

Cobb.—On Jne. 27, at the B.M.H., Tidworth, to Rosamond, wife of Wing Commander H. J. Cobb, R.A.F.—a daughter.

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INDEX TO ADVERTISERS

Name	Page
A	
Aer Lingus	17
Aero Controls, Ltd.	3
Airwork Services, Ltd.	15
Alvis, Ltd.	11
Astraeus, Ltd.	15
Attewell, B., & Sons, Ltd.	18
B	
Bolton Gate Co., Ltd.	3
British Aircraft Corporation, Ltd.	8, 9
British Executive and General Aviation, Ltd.	5
British Timken: Division of the Timken Roller Bearing Co.	Inside Front Cover
Burnley Aircraft, Ltd.	Inside Back Cover
C	
Central Office of Information: Royal Air Force Recruiting	17
Civil Service Commission	18
Cross Manufacturing Co. (1938) Ltd.	14, 15
Cunard Eagle Airways, Ltd.	13, 15
D	
Decca Radar, Ltd.	16
Desoutter Bros., Ltd.	12
E	
Elliott-Automation, Ltd.	2
F	
Flight Refuelling, Ltd.	10
H	
Harleyford Publications, Ltd.	2
Hawker Siddeley Aviation, Ltd.	4, 7
Hunting Aircraft, Ltd.	18
I	
International Aeradio, Ltd.	15
K	
Keegan Aviation, Ltd.	14
L	
Lucas Gas Turbine Equipment, Ltd.	Front Cover
M	
Marshall's Flying School, Ltd.	15
Ministry of Aviation	16
P	
Pressed Steel Co., Ltd.	16
R	
Rye, Claude, Bearings, Ltd.	18
S	
Scottish Aviation, Ltd.	3
Sperry Gyroscope Co., Ltd.	6
T	
Technivision, Ltd.	16
Titanine, Ltd.	1
Tradair Ltd.	16
W	
Whittemore, A. J., (Aeradio), Ltd.	16
Wiggin, Henry, & Co., Ltd.	Back Cover

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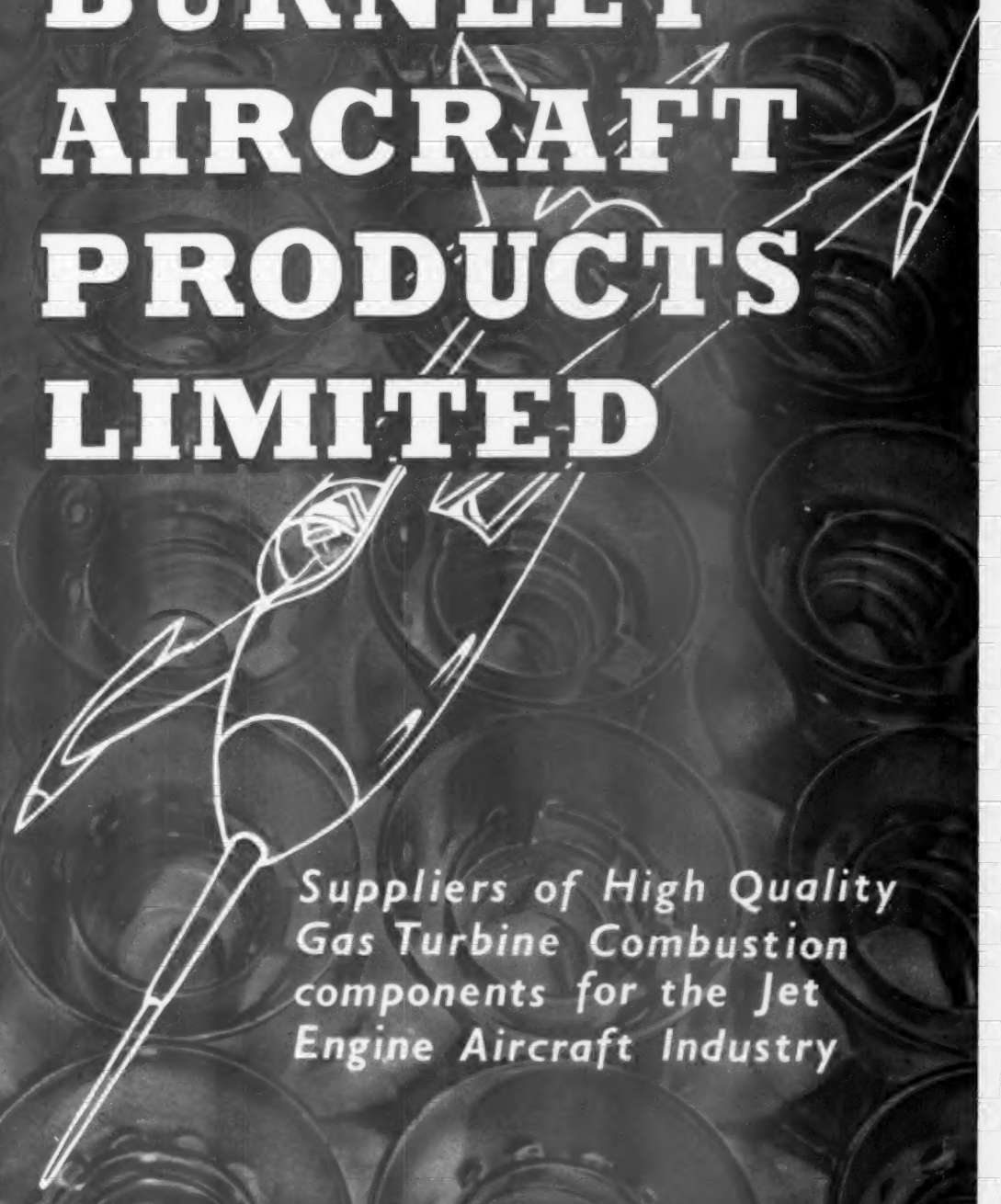

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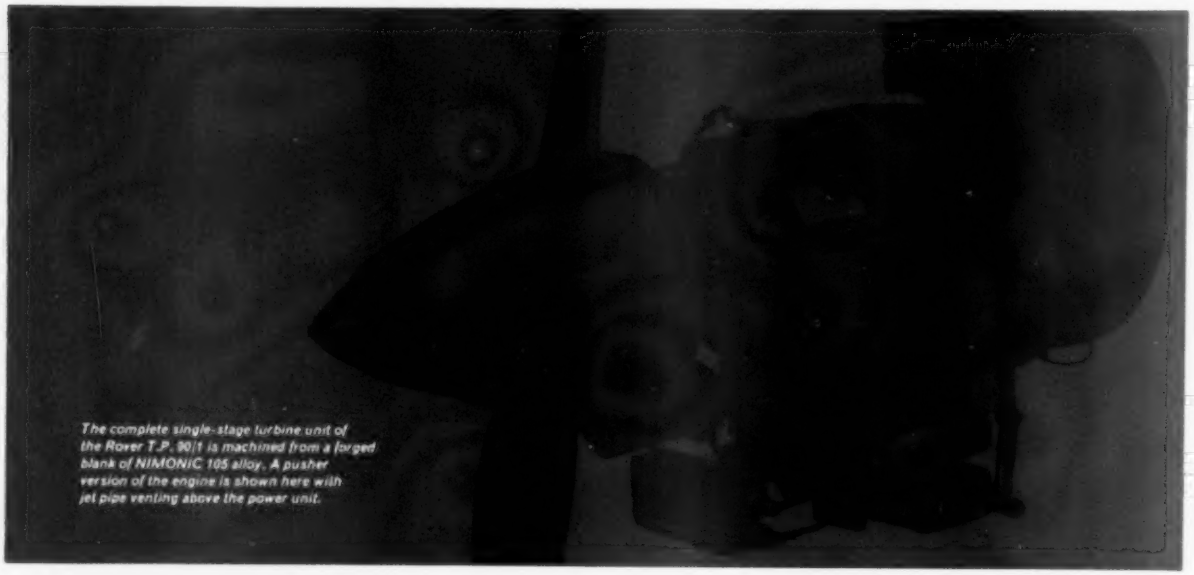

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